VOLUME 7[illegible] [W. B. No. [illegible]] NUMBER 3

UNITED STATES DEPARTMENT OF COMMERCE
J[illegible] H. JONES, *Secretary*

WEATHER BUREAU F. W. Reichelderfer, *Chief*

MONTHLY WEATHER REVIEW

MARCH 1943

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MONTHLY WEATHER REVIEW

Editor, EDGAR W. WOOLARD

VOL. 71, No. 3
W. B. No. 1380

MARCH 1943

CLOSED MAY 5, 1943
ISSUED JUNE 8, 1943

THE REMARKABLE TEMPERATURE FLUCTUATIONS IN THE BLACK HILLS REGION, JANUARY 1943*

By ROLAND R. HAMANN

[U. S. Weather Bureau, Rapid City, S. Dak., March 1943]

On January 22, 1943, temperature fluctuations of incredible magnitude and rapidity occurred on the slopes of the Black Hills in South Dakota. Some of the changes observed at Rapid City attracted Nation-wide attention.

This region is habitually subject to surprising temperature changes. Indeed, the chinook is so prevalent that it may be considered a prominent climatological factor. Some of the outstanding temperature changes contained in the Rapid City record are as follows: The greatest daily range at Rapid City was observed on January 13, 1913, when the temperature rose from −17° at 8 a.m. to 47° above zero at 10 p.m., a rise of 64° in 14 hours. The greatest 24-hour rise in temperature occurred on December 28–29, 1933; on this occasion the mercury climbed from zero at 8 p.m. on December 28 to 67° above zero at 1:45 p.m. on December 29. On January 10, 1911, the temperature dropped from 55° at 7 a.m. to 8° above zero at 7:15 a.m.; cold weather continued until January 12, when the temperature rose from 13° to 43° within 10 minutes, between 1:30 and 1:40 a.m.; at 6 a.m. the temperature stood at 49°, but fell to 13° below zero by 8 a.m., a drop of 62° in two hours.

Because of such temperature variations this region has achieved some measure of fame, or notoriety, but even these precedents were inadequate preparation for the occurrences of January 22, 1943.

The phenomenon first became manifest at Spearfish, S. Dak., at 7:32 a. m. when a rise of 49° was recorded *within 2 minutes.* (−4° to 45°.) After many sharp variations, the mercury plunged from 54° at 9 a. m. to −4° at 9:27 a. m. Sturgis, S. Dak., experienced a similar sequence of slightly less marked changes beginning 52 minutes later. As the phenomenon progressed southward, Rapid City came under its influence. Beginning at 10:29 a. m. a sudden warming of 32° occurred within 4 minutes, which was succeeded at 10:36 a. m. by a drop of 22° within 3 minutes, only to rise immediately from 20° to 56° within 5 minutes. And so it continued with such changes as from 60° at 11:57 a. m. to 13° at 12:02 p. m.; from 15° at 12:35 p. m. to 50° at 12:46 p. m.; and from 58° at 5:22 p. m. to 17° at 5:26 p. m. Little wonder the oldest settlers could recall no parallel.

The changes experienced chronologically by a stationary observer were startling enough, but to the motorist and pedestrian were even more so. At 11 a.m. on the east side of the Alex Johnson Hotel in Rapid City, winter was in all its glory, while around the corner on the south side, not 50 feet away, spring held sway, only to be swept away in a flash by the sting of winter, and then to return. Motorists were forced to park, unable to immediately remove a thick frost that appeared almost instantly on windshields, so sudden and warm was the wind. Streets were coated instantly with a peculiar light frost. Similar reports came from all over the region, and in practically all cases the sharpest differences were coincident with changes in elevation.

The Black Hills are an anticlinal or elongated dome-shaped mass, culminating in peaks over 7,200 feet above sea level and sloping down abruptly to 3,000 feet on the east, and gradually on the west to 4,200 feet. Actually, they are the highest mountains between the Atlantic Ocean and the Rocky Mountains. Five major ranges traverse the region from north to south. The most westerly of these is an infacing, limestone escarpment at a mean elevation of 6,800 feet. The region lies principally within parallels 43° to 45° north latitude, and meridians 103° to 104°30′ west longitude; it is largely in South Dakota, partly in Wyoming; and is about 125 miles long in a north-northwesterly and southerly direction, and about 65 miles in width. (See fig. 1.)

While the more sensational and newsworthy variations occurred on January 22, the situation had been developing for several days previously.

On January 15 an outbreak of extremely cold Continental Arctic air invaded the Great Plains region and thereafter became stagnant, with the Black Hills near the western edge of the air mass. This produced the lowest temperatures observed for several years at many stations in the Great Plains and the Black Hills. By January 19 the extreme western edge of the air mass had moderated somewhat and was now classified Continental Polar warm air, but the Black Hills remained in the subzero air behind a cold front about 200 miles to the south and west. The front moved near the Hills on January 20 and had become quite stationary. Dynamically heated Maritime Polar air, under the influence of a strong depression over the Pacific Northwest, began overrunning the wedge of cold air in Montana and northeastern Wyoming early on January 20. The early morning sounding at Great Falls, Mont., indicated a strong upper inversion from 7,400 feet to 8,800 feet.

The surface position of the front on January 20 was about 150 miles west and south of the Black Hills on a northwest-southeast line; and though the front was later indicated in a position nearer the Black Hills, data available to the analyst did not justify placing the front east of the Black Hills at any time during the period under consideration. Yet, warm air did appear at all elevations above 4,500 feet.

While towns and villages at lower elevations were still in the grip of this winter's severest weather, Lead, Custer,

*Unless otherwise noted, all temperatures in this paper are in the Fahrenheit scale.—Ed.

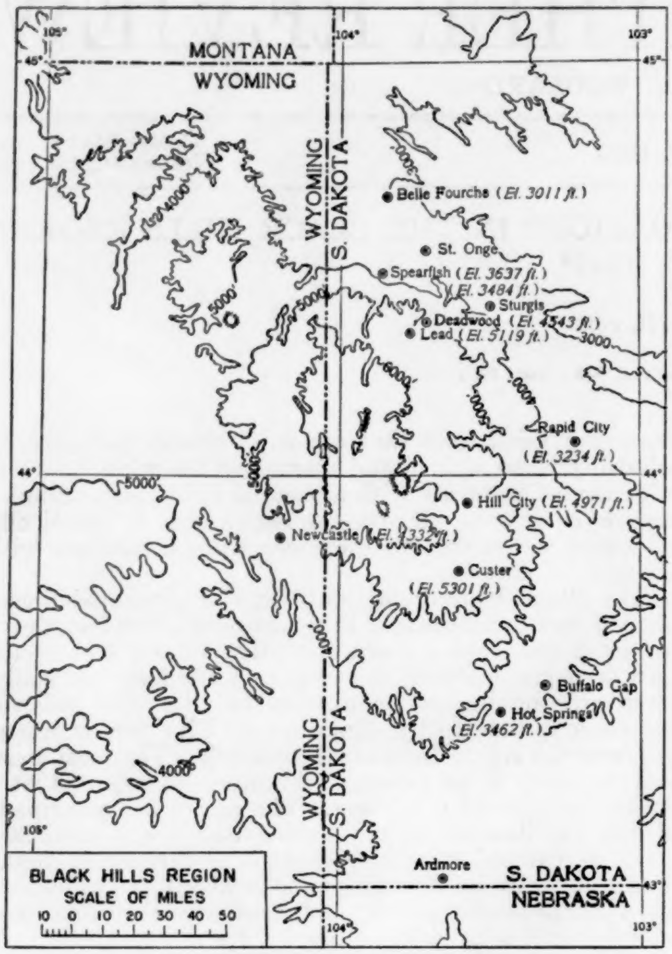


FIGURE 1.—Sketch of the Black Hills region.

Mount Rushmore, Hill City, and all inhabited higher elevations reported "chinooks" and other "mysterious" temperature rises on January 20. This warm air gradually progressed to lower elevations until January 22. Of course, minor recessions occurred, but the higher stations, such as Lead, Hill City, and Custer, were constantly in the warm air after January 20.

The warm air which arrived at Lead before noon was not felt at Deadwood until evening. Deadwood is 3 miles northeast of Lead and 600 feet lower. The elevation at Lead is 5,119 feet.

In the northern Hills, warm air was not in evidence below 4,500 feet until January 22. The Black Hills airport, about 10 miles north of Deadwood at an elevation of 3,913 feet, remained severely cold until January 22. However, relatively lower elevations in the southern Hills received temporary relief during the early morning hours of January 21. Hot Springs, 3,442 feet, was up 60° at 6 a. m., January 21, from the lowest temperature of January 20, but at 7:30 a. m. temperatures again had fallen to −2° from a peak of 40° at 6 a. m. This recession also was noted at Deadwood; here it occurred at 4:30 a. m. with a fall of 48° within a few minutes.

As the front approached on January 21 and 22, its orientation relative to the Hills remained the same, but the southern portion of the Black Hills was nearer the surface position of the front. As this situation developed, warm air began to appear at lower elevations. This fact and all available data strongly suggest a penetration of the frontal surface, with the line of temperature discontinuity determined by the slope of the frontal surface. Indeed, this seems the only logical assumption. For in no other manner is it possible to account for the astonishing temperature differences of January 22, recorded on the eastern (steep) side of the Black Hills.

If we attempt to explain these discontinuities on the basis of horizontal motions of a surface front, the wave-like pattern of the fluctuations observed on the Spearfish–Sturgis–Rapid City-line would necessarily have been due to a disturbance of the front which would have been propagated laterally from north to south in the manner of a standing wave. Examination of the temperature traces shows wave lengths too small and amplitudes too large to attribute to motions of a surface front, considering the energy involved; also, the disturbances ceased suddenly and systematically from north to south, whereas a standing wave would be expected to diminish gradually in amplitude along the entire line.

The phenomenon is more easily explained if we look to possible causes in the cold air beneath the frontal surface. On January 21 an upper inversion had developed at Bismarck, N. Dak., with its base at 3,400 feet. Twenty-four hours later the base of this inversion had moved upward to 4,600 feet. The position of the surface front south of the Black Hills had not changed greatly.

Therefore we may assume that a fresh outbreak of cold air had steepened the frontal slope. Upon reaching the rough terrain of the Black Hills the resulting turbulence in this accelerating cold air easily could have disturbed the configuration of the frontal slope in the manner required to produce the observed results. The definite southerly motion of the surface front observed in the Missouri Valley on the following day seems to justify the assumption of a fresh outbreak of cold air. By the evening of January 23 the entire Black Hills region was submerged by the cold air under the frontal surface. Though complete data are not available, our information is sufficient to place the line of temperature discontinuity, for practically the entire period, between Lead and Spearfish, elevations 5,119 feet and 3,637 feet, respectively, in the northern hills; between Lead and Sturgis, 3,452 feet, and Hill City, 4,976 feet, and Rapid City, 3,219 feet, on the eastern slope; and between Custer, 5,301 feet, and Hot Springs, 3,443 feet, in the southern hills. Spearfish, Sturgis, Rapid City, and Buffalo Gap reported low temperatures throughout the period, except on the 22d when the warm air reached its lowest elevations. Data for the western slope are scanty, but it is believed the recessions and propagations at Lead and Deadwood may be assumed to have occurred over the entire region, though at higher levels to the north.

Perhaps a better analogy may be obtained if we consider the Black Hills region to be, in this instance, an island engulfed by a sea of cold air, shallow to the south (near the surface position of the front) and deeper to the north. As the tide moves northward, lower elevations on the island become exposed to the warm air above the sloping surface of the sea of cold air; but waves on the surface of this cold fluid continue to cause extremely sharp variations on the shore line. Finally at low ebb, the shore line recedes and almost the entire island emerges from the cold fluid. Soon thereafter the tide is reversed and the cold air becomes progressively deeper, with some irregularities due to the rugged conformation of the bottom, until the entire island is submerged.

While this phenomenon was popularly believed to be due to a chinook, it is doubtful whether any considerable dynamic heating took place over the Black Hills. Undoubtedly, the overrunning Maritime Polar air had been already modified by dynamic heating in its passage over

the Rocky and Big Horn Mountains. Large temperature discontinuities already existed across the surface front in Wyoming when this airmass appeared on January 20.

Pilot-balloon observations and pilot reports from aircraft at Rapid City indicated a strong current of overrunning warm air within a few thousand feet of the surface as early as January 20. At levels above the highest elevations in the Black Hills, velocities generally exceeded 70 m. p. h. Such vigorous overrunning of the stationary cold mass to the east accounts for the large body of Superior air over the central and southern Great Plains noted on the surface charts of January 22 and 23. This subsidence air was returned to eastern Wyoming by southeasterly surface winds—further intensifying the temperature discontinuity. A difference of 70° was noted between Sheridan, Wyo., and Lewistown, Mont., on January 22; while on January 21, passage of the front contributed to a range of 75° at Box Butte, Nebr. Daily ranges exceeding 50° were numerous at stations in Wyoming and Nebraska which were near the front from January 19 to 23. In addition to the unprecedented temperature range reported at Box Butte, Nebr., outstanding changes include a range of 66° at Torrington, Wyo., on January 19; 65° at Harrison, Nebr., on January 21; and 61° at Clearmont, Wyo., on January 22.

Local chinook effects possibly contributed to conditions observed in the Black Hills, but it is evident that the phenomenon was essentially the result of the wavering motion of a pronounced quasi-stationary front separating Continental Arctic air from Maritime Polar air. The position of the front at 6-hour intervals is shown in figure 2.

Among many interesting and informative letters received is the following from Cedric A. Barnes, Chief Airway Communicator, Black Hills Airport, Spearfish, S. Dak.

JANUARY 22, 1943.

I live at St. Onge, about 5 miles north and 3 miles east of the station. When I left, the temperature was between 5° and 10° below zero F., which was expected. About half way south, the windshield on the car frosted so suddenly and so heavily that I was well toward the ditch before I could get stopped. When I got out to clean the windshield of the car, it felt like a warm spring day with about 15 miles of wind from the SW. When I reached the station, about 8:15 a. m. the temperature was 45° F., with WSW 44-mile wind, and rain showers. Having no extra thermometer at the station, I took the operator who had just gone off watch, and returned to St. Onge, where I had a glass, centigrade, chemical thermometer, which I knew was reasonably accurate. We left St. Onge about 9:15 a. m. The indicated temperature was then −18.0° C. In the next 2 miles the temperature rose to −16.1° C. In the next ¼ mile it raised to −13.0° C. This distance is in a creek bottom from 20 to 50 feet below the surrounding land. In the next 200 to 300 feet, the windshield frosted as it had before. We got out to clean it. From tracks in the snow we found that *we were only 10 feet from where I had stopped an hour before!* The thermometer read plus 9.8 C.° We had come up about *20 feet* out of the creek bottom. A little further south and a little higher up we looked back. There was a line of white, thick stratus following the creek, the tops from 100 to 150 feet above the surface, with heavy snow blowing from the northeast. The wind was about 30 mile SW where we were, ¼ mile away.

L. M. Jones, Weather Bureau inspector traveling in the vicinity at the time, writes:

On my way to Rapid City a day or two later I overheard discussions and comments about this strange phenomenon at nearly every stop I made. The changes took place over a rather wide area, but were much more pronounced at some places than at others. While some of the most pronounced and rapid changes were experienced at Rapid City, there was perhaps greater contrast in temperature at Lead and Deadwood. There is such a short distance between these two towns (2 to 3 miles between business sections) that they seem like one town, except that Deadwood lies in the canyon and Lead is built at a higher elevation. At one time it was reported that the temperature at Lead was 52° while at the same time it was -16° at Deadwood. Several plateglass windows were cracked in the downtown section of Lead because of the rapid rise in temperature.

The official in charge at Rapid City, Harley N. Johnson, has furnished the Central Office with a photostatic copy of an unofficial Bristol-type thermograph record made at Rapid City during the week ending Monday, January 25, 1943, and considered to be entirely reliable (see figure 2). The record includes the phenomenal temperature fluctuations which took place in that area on Friday, January 22, 1943.

Following are readings taken from the record, together with temperatures observed at the regular 6-hourly observations at the airport:

The city area is much more favorably situated at the very foot of the Black Hills to receive blasts of descending air from the west or southwest. From the reproduced thermograph record it can be seen that sudden puffs of warm air reached the city at frequent intervals during the morning. After 12:30 p. m., the warm air completely enveloped the city area and continued thoughout the afternoon.

Time (MWT)	Bristol recorder (city)	
	Temperature	Remarks and change
	°F.	
5:30 a. m.	−5	Slow rise for 4 hours.
9:20 a. m.	5	+10°.
9:40 a. m.	54	+49°.
10:30 a. m.	11	−43°.
10:45 a. m.	55	+44°.
11:30 a. m.	10	−45°.
11:50 a. m.	34	+24°.
12:15 p. m.	16	−18°.
12:40 p. m.	56	+40°, stationary all afternoon.
4:00 p. m.	56	
5:00 p. m.	12	−42°, slow, steady fall.
7:30 p. m.	5	−7.

Time (MWT)	Rapid City Airport (8 miles northeast of the city)	
	Temperature	Remarks
	°F.	
6:30 a. m.	−8	Airport continued in the cold air until afternoon.
12:30 p. m.	3	Some time during the afternoon, the temperature reached 50°.
6:30 p. m.	6	

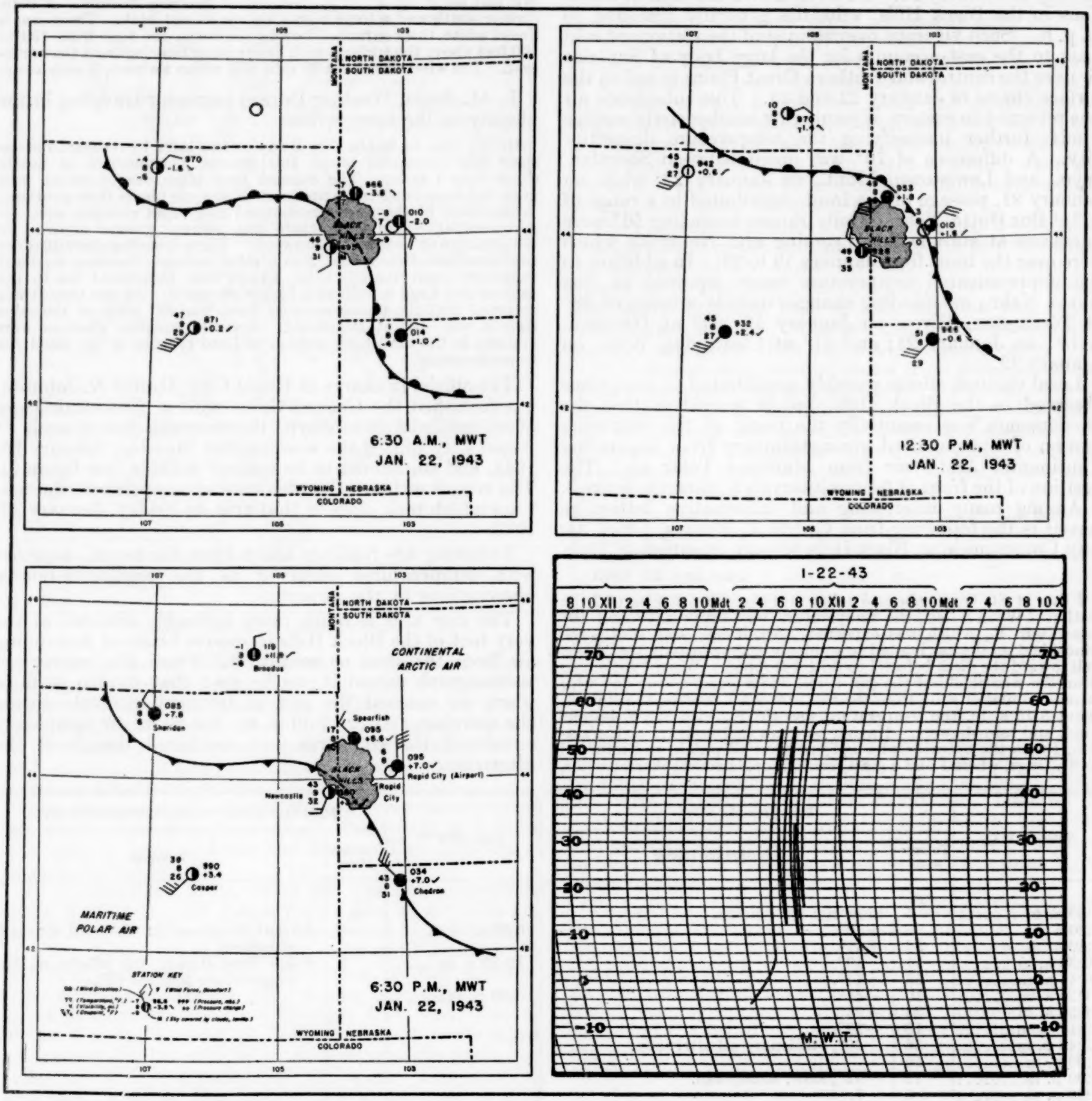


FIGURE 2.—*Upper left, upper right, and lower left,* position of the front on January 22, 1943, at 6-hour intervals; *lower right,* Bristol-type thermogram at Rapid City during the week of January 19–25, inclusive, showing the phenomenal fluctuations on January 22.

METEOROLOGICAL AND CLIMATOLOGICAL DATA FOR MARCH 1943

[Climate and Crop Weather Division, J. B. KINCER, in charge]

AEROLOGICAL OBSERVATIONS

NOTICE.—Effective with the December 1942 issue, the publication of table 1 (RAOB summaries) was discontinued indefinitely.—EDITOR.

TABLE 2.—*Free-air resultant winds based on pilot-balloon observations made near 5 p. m. (75th meridian time) during March, 1943. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Velocities in meters per second*

Altitude (meters) m. s. l.	Abilene, Tex. (538 m.)			Albuquerque, N. Mex. (1,630 m.)			Atlanta, Ga. (299 m.)			Billings, Mont. (1,095 m.)			Bismarck, N. Dak. (512 m.)			Boise, Idaho (870 m.)			Brownsville, Tex. (7 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	30	183	2.4	31	266	3.5	27	201	1.2	29	249	3.6	28	294	2.7	31	9	0.5	28	118	3.9
500							27	222	1.5										28	133	4.6
1,000	30	172	2.7				27	214	3.6				28	287	4.2	31	308	6.1	25	166	3.0
1,500	28	224	2.5				25	224	5.2	29	270	6.1	23	297	6.1	31	263	1.9	19	269	3.3
2,000	28	257	6.9	31	270	4.3	22	258	6.4	27	286	10.2	21	286	8.1	31	264	5.1	14	255	4.9
2,500	27	261	9.2	31	279	5.1	21	265	8.9	25	289	11.9	19	284	9.6	29	276	6.4	13	259	5.1
3,000	26	259	11.2	30	273	7.4	17	285	11.2	23	285	11.8	19	286	10.6	27	275	8.0	13	267	7.2
4,000	24	263	14.2	26	276	10.8	13	279	12.7	19	295	14.8	18	288	13.7	23	286	10.6	12	260	11.0
5,000	22	265	16.6	21	285	14.5	10	278	17.5	16	296	16.0	13	290	14.7	17	293	12.9	12	264	10.3
6,000	21	269	19.6	17	282	18.6				13	303	16.5	11	289	15.6	15	302	15.2	11	257	13.6
8,000	15	272	23.3	11	290	18.4															
10,000																					
12,000																					
14,000																					

Altitude (meters) m. s. l.	Buffalo, N. Y. (220 m.)			Burlington, Vt. (132 m.)			Charleston, S. C. (17 m.)			Cincinnati, Ohio (152 m.)			Denver, Colo. (1,627 m.)			El Paso, Tex. (1,196 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	31	246	4.8	29	290	0.7	29	185	0.8	27	239	2.1	29	16	0.9	31	260	4.9
500	31	250	7.6	29	256	2.9	29	209	1.9	27	242	3.7						
1,000	27	248	9.0	27	266	6.7	22	257	3.5	26	232	5.1						
1,500	20	269	9.4	24	269	7.8	22	271	4.5	24	249	5.9				31	252	4.9
2,000	16	273	13.1	19	281	10.2	18	259	7.1	21	260	9.1	29	320	1.3	31	254	5.2
2,500	10	289	12.9	15	283	13.7	16	265	10.2	19	269	10.9	29	295	3.0	31	266	7.1
3,000				11	284	15.6	16	265	11.8	17	275	12.5	27	284	6.1	30	273	8.6
4,000							15	278	15.0	12	282	14.4	25	281	11.2	25	275	13.2
5,000							10	279	16.7				22	288	16.7	21	280	13.1
6,000							10	277	19.3				20	288	19.5	18	275	15.0
8,000													14	291	21.2	12	286	15.8
10,000																		
12,000																		
14,000																		

Altitude (meters) m. s. l.	Ely, Nev. (1,910 m.)			Grand Junction, Colo. (1,413 m.)			Greensboro, N. C. (271 m.)			Havre, Mont. (767 m.)			Jacksonville, Fla. (16 m.)			Joliet, Ill. (178 m.)			Las Vegas, Nev. (573 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	31	282	1.5	30	297	2.6	29	235	1.5	29	270	3.9	28	93	3.5	29	249	3.1	31	69	0.7
500							29	236	2.1				28	142	2.0	29	247	4.5			
1,000							28	240	3.8	29	269	7.0	27	210	3.0	28	254	5.7	31	190	0.2
1,500				30	287	2.9	27	247	6.3	29	281	9.2	27	238	5.0	26	257	8.7	31	232	1.5
2,000	31	266	1.7	30	282	3.8	25	250	8.1	28	285	11.1	25	258	6.3	21	266	11.7	31	246	3.1
2,500	31	287	2.7	30	266	4.2	23	260	10.0	23	288	12.6	22	258	7.7	17	274	14.2	30	267	4.2
3,000	31	274	4.1	29	257	6.2	19	269	10.4	18	293	13.6	20	266	9.8	15	280	13.9	29	284	5.3
4,000	19	291	8.0	24	278	9.3	16	270	13.9	14	295	11.9	19	265	11.3				26	286	8.8
5,000	17	302	10.1	15	280	13.1	15	271	16.4				16	271	13.4				25	289	11.1
6,000	15	302	13.4	11	282	13.7	14	278	16.4				15	275	15.2				25	289	13.5
8,000	11	310	18.4				11	273	22.2				13	279	17.1				16	304	15.8
10,000	10	314	22.7										12	283	21.4				14	307	20.5
12,000																			10	291	21.6
14,000																					

Altitude (meters) m. s. l.	Little Rock, Ark. (88 m.)			Medford, Oreg. (410 m.)			Miami, Fla. (15 m.)			Mobile, Ala. (66 m.)			Nashville, Tenn. (194 m.)			New York, N. Y. (15 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	27	118	1.3	31	304	1.4	31	116	3.2	28	117	0.7	29	240	1.0	26	297	3.4
500	27	141	1.2	31	309	1.6	31	109	4.4	28	154	1.2	29	235	2.2	26	281	4.1
1,000	24	239	2.1	31	250	1.9	29	112	3.5	21	307	0.7	28	226	3.0	23	279	7.4
1,500	24	239	4.3	30	231	4.0	27	126	1.6	17	317	3.7	22	238	3.9	21	281	10.2
2,000	22	264	5.6	27	237	5.0	22	212	2.2	16	291	5.9	20	264	6.9	17	276	10.7
2,500	21	269	7.9	25	249	6.4	18	215	2.5	15	277	7.2	19	275	8.4	16	283	13.2
3,000	20	266	9.7	21	263	6.0	18	242	3.5	12	291	8.5	18	282	10.2	11	280	13.7
4,000	15	265	12.2	17	289	6.7	15	243	4.2	12	286	13.2	17	280	14.9			
5,000	12	278	14.5	16	297	8.3	14	258	6.0				17	283	18.7			
6,000				11	315	11.7	12	275	8.2				13	290	21.3			
8,000							10	270	10.4				10	287	24.9			
10,000																		
12,000																		
14,000																		

Altitude (meters) m.s.l.	Oakland, Calif. (8 m.)			Oklahoma City, Okla. (402 m.)			Omaha, Nebr. (306 m.)			Phoenix, Ariz. (388 m.)			Rapid City, S. Dak. (982 m.)			St. Louis, Mo. (181 m.)			St. Paul, Minn. (225 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	30	250	3.5	26	168	2.1	29	243	2.0	31	261	1.8	30	353	2.4	28	229	2.0	29	262	2.1
500	30	264	2.2	26	171	2.6	29	246	2.6	31	248	2.4				28	250	3.0	29	268	3.0
1,000	27	243	1.3	26	190	3.4	28	237	5.1	31	253	3.0	30	353	2.4	27	255	7.7	24	263	5.5
1,500	23	289	1.8	25	229	3.1	28	260	6.6	31	247	3.4	30	309	3.8	25	261	7.0	19	267	7.5
2,000	20	292	3.4	24	255	5.4	24	266	9.9	29	256	4.4	29	301	7.1	23	266	9.3	18	273	9.8
2,500	19	289	3.5	22	260	8.7	20	278	10.7	28	265	6.1	23	290	9.7	20	270	9.1	18	276	12.3
3,000	19	281	5.0	22	266	12.5	18	285	12.8	27	269	8.0	22	286	12.3	18	274	10.3	16	276	12.5
4,000	17	293	6.7	21	270	15.5	14	289	14.2	26	277	10.2	20	290	14.1	16	283	12.6	12	287	14.5
5,000	16	294	8.0	18	271	19.4	11	283	17.3	22	283	13.4	17	288	15.9	11	289	13.9	10	287	15.4
6,000	16	287	10.5	17	276	24.3				22	279	15.3	14	289	17.6						
8,000	14	284	14.4	11	278	22.0				19	272	22.3									
10,000	13	289	22.8							14	283	24.0									
12,000																					
14,000																					

Altitude (meters) m.s.l.	San Antonio, Tex. (240 m.)			San Diego, Calif. (15 m.)			Sault Ste. Marie, Mich. (230 m.)			Seattle, Wash. (12 m.)			Spokane Wash. (603 m.)			Washington, D. C. (24 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	31	103	2.3	30	280	3.8	25	303	3.2	28	219	2.5	31	216	1.4	29	250	2.1
500	31	127	1.9	30	286	3.3	25	302	3.8	28	217	3.1				29	251	3.6
1,000	28	144	0.7	28	283	2.3	21	282	6.8	23	208	2.6	31	232	3.6	27	254	5.4
1,500	25	249	2.4	26	298	3.1	18	286	10.6	20	208	2.9	28	237	4.8	27	257	7.9
2,000	20	257	5.3	20	293	4.5	15	281	11.9	19	227	2.3	25	241	6.0	23	270	10.6
2,500	18	251	7.2	17	300	5.0	15	287	13.9	16	271	2.1	18	280	5.1	19	276	12.1
3,000	17	261	9.0	16	291	6.4	14	292	15.0	15	287	4.8	14	318	6.3	17	280	15.0
4,000	15	270	13.3	13	302	7.4	12	294	17.7	10	303	6.8	12	320	11.0	15	273	18.5
5,000	14	274	14.8	13	300	9.5	10	292	19.5				11	307	14.7	13	288	19.3
6,000	13	268	16.1	10	307	8.7							10	301	17.6	12	290	22.6
8,000																		
10,000																		
12,000																		
14,000																		

TABLE 3.—*Maximum free-air wind velocities (m. p. s.), for different sections of the United States. Based on pilot-balloon observations during March 1943*

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum velocity	Direction	Altitude (m) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m) m. s. l.	Date	Station
Northeast [1]	46.0	w.	2,180	17	Toledo, Ohio	54.6	wsw.	5,000	2	Caribou, Maine	70.0	sw.	8,380	1	Caribou, Maine.
East-Central [2]	40.0	wsw.	1,650	6	Raleigh, N. C	50.0	wsw.	4,700	7	Washington, D. C	73.0	w.	8,360	1	Huntington, W. Va.
Southeast [3]	30.0	w.	1,550	3	Charleston, S. C	49.0	w.	4,840	3	Atlanta, Ga	65.5	wnw.	11,600	23	Tampa, Fla.
North-Central [4]	47.6	s.	820	30	International Falls, Minn.	62.9	wnw.	5,000	26	International Falls, Minn.	63.0	wnw.	5,020	26	International Falls, Minn.
Central [5]	62.0	ssw.	2,380	30	Dodge City, Kans	54.4	w.	2,550	17	Des Moines, Iowa	59.6	sw.	10,560	19	Wichita, Kans.
South-Central [6]	42.5	sw.	1,200	15	Oklahoma City, Okla.	44.2	w.	4,810	16	Oklahoma City, Okla.	64.0	wnw.	9.690	3	Oklahoma City, Okla.
Northwest [7]	47.4	wnw.	2,260	30	Billings, Mont	53.0	wnw.	4,420	12	Billings, Mont	70.0	nw.	9,330	15	Tatoosh Island, Wash.
West-Central [8]	36.4	w.	2,480	8	Cheyenne, Wyo	45.9	wnw.	5,000	14	Redding, Calif	63.0	wnw.	10,330	21	Cheyenne, Wyo.
Southwest [9]	48.2	sw.	2,290	18	Winslow, Ariz	62.0	w.	4,800	15	Roswell, N. Mex	68.1	wnw.	10,570	5	Las Vegas, Nev.

[1] Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and Northern Ohio.
[2] Delaware, Maryland, Virginia, West Virginia, southern Ohio, Kentucky, eastern Tennessee, and North Carolina.
[3] South Carolina, Georgia, Florida, and Alabama.
[4] Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.
[5] Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.
[6] Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and western Tennessee.
[7] Montana, Idaho, Washington, and Oregon.
[8] Wyoming, Colorado, Utah, northern Nevada, and northern California.
[9] Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.

RIVER STAGES AND FLOODS

By BENNETT SWENSON

Following the driest February of record, with only three States having as much as normal precipitation, March was above normal except in the Northeastern States and in most of the Plains States. The western Lake region, most of the Ohio Valley and a large southeastern area had a considerable excess of precipitation. The March average for the entire country was 2.78 inches, or 2 percent above normal. This was the first month so far this year with as much as normal precipitation. The Nationwide average for the first quarter of the year was 88 percent of normal with some of the interior sections having had only a little more than half of the normal.

The temperatures during March were well below normal over most of the country, the only sections having above normal being the Middle Atlantic States, the Pacific coast and the far Southwest. The subnormal temperatures were most pronounced in Montana. However, in that State, the weather changed abruptly in the last week of the month and unseasonably high temperatures and chinook effects melted the snow at lower elevations in the Missouri Basin. This snow melt produced the highest discharge of record at Bismarck and the highest stages since 1881 were experienced in the Missouri as far downstream as below Omaha, Nebr., in April.

Floods were widespread from heavy rains in the Gulf States, the lower Ohio River and tributaries, and in California. The rapid melting of the low-altitude snow cover in Montana and North Dakota caused destructive ice jams and floods in the upper Missouri Basin.

St. Lawrence Drainage.—Minor floods occurred in the Grand and Saginaw River Basins in Michigan and in the Maumee River at Fort Wayne, Ind., during the month. Damage amounting to about $50,000 was reported in the Grand River Basin.

The rivers were above normal from rains early in March. Heavy rains averaging 2 inches fell over most of these watersheds on March 15 and 16. These rains, combined with moderately high temperatures on several days, caused the ice to break up and the rivers to rise rapidly, reaching near or slightly above flood stages. The Childsdale Dam on Rogue River, a tributary of the Grand River, gave way on March 16, resulting in overflow at the confluence of the Rogue and Grand Rivers.

Atlantic Slope Drainage.—In New England, precipitation was light during March. However, snow melt in the lower elevations caused rises in the streams to moderately above normal except in northern Maine. At Concord, N. H., the ice in the Merrimack River broke up on March 26 and in the Connecticut the ice began moving out on the 13th. An ice jam formed in the vicinity of White River Junction, Vt., causing the stage to go slightly above flood stage there on March 13 and again on the 19th.

Moderately high temperatures on the 15th–16th caused some melting of the snow cover in the Mohawk River Basin. Numerous small ice jams formed on that river and Schenectady, N. Y., experienced a slight amount of flooding on the 17th.

A rise occurred in the upper reaches of the Susquehanna River on March 16–17. The rise, which resulted chiefly from snow melt in the portion of the North Branch of the Susquehanna in New York, caused moderate flood stages at several points, mostly confined to New York.

Light floods occured in most of the streams of eastern North Carolina and South Carolina, and in the Savannah River from frequent rains during the month. No damage of consequence resulted.

Moderately high floods were experienced in the Altamaha River system. Several periods of heavy rainfall occurred over the basin during the month, but none were of flood producing proportions until the heavy rains of the 17th to the 22d. On the morning of the 17th the precipitation averaged about 1 inch in the upper Ocmulgee River Basin, and slightly less than 1 inch in the upper Oconee Basin. Rains of over 1 inch were again reported on the 18th. During the period, 20th–22d, rains in the Ocmulgee Basin averaged 2 inches, and in the Oconee, 1.5 inches. This latter period of precipitation was sufficient to produce stages ranging from 3 to 5 feet above flood stage in the Ocmulgee, and from 9 feet above at Milledgeville, Ga., to 3 feet above at Mount Vernon, Ga., in the Oconee.

East Gulf of Mexico Drainage.—Heavy rains occurred on the 5th–6th, and in the northern portion on the 11th–12th. These rains were followed by unusually heavy falls

from the 17th to 21st, the heaviest concentrations coming on the 19th and 20th. The greatest monthly totals were recorded in the Leaf River Basin, covering about 3,000 square miles, where the average rainfall was 12¾ inches. Of this total, almost 70 percent fell in the period of 5 days from the 17th to the 21st.

Severe flooding resulted in most of the drainage, particularly in southeastern Louisiana and southern Mississippi where record, or near record, stages were reached.

The excessive prepitation on the 19th and 20th was associated with earlier excessive rains in the lower Ohio Basin which caused extensive flooding in that basin. A discussion of the meteorological aspects of the storms causing these rains is given herewith.

On the morning of the 18th, the surface weather map showed a low-pressure system centered over the Texas Panhandle with a stationary front extending east-northeastward to the lower Ohio Valley. A strongly developing disturbance over southern Nevada retarded the eastward progress of the Texas Low.

A strong anticyclonic circulation over the southeastern United States extended to high altitudes and produced a strong inflow of moist tropical air over the Gulf States. Overrunning of this moist air over a cold air mass present over the lower Ohio Basin began to produce heavy rains in that area during the early afternoon of the 18th.

By evening the two disturbances had merged over northern Texas and the system began moving northeastward, and was centered over southeastern Missouri on the morning of the 19th. An active warm front extended eastward from the low center across Kentucky with the heaviest precipitation confined to the lower two-thirds of the Ohio Basin. The cold front extended from southeastern Missouri southwestward through central Arkansas and eastern Texas moving slowly eastward.

The disturbance moved rapidly north-northeastward, occluding over Lower Michigan by 8:30 p. m. of the 19th. Precipitation at this time decreased in intensity and was confined to the upper Ohio Basin. The cold front moved rather rapidly eastward over the Ohio Basin but the southern portion of the front was slowed up in its movement across the Gulf States. Oscillations of this portion of the front produced heavy rains in southeastern Louisiana and southern Mississippi during the night of the 19th–20th.

A wave formed along the front in the Gulf of Mexico south of the Louisiana coast during the night of the 20th, and by 8:30 a. m. of the 21st had developed into an intensive LOW centered over southeastern Alabama. Excessive rains in southeastern Louisiana, southern Mississippi, most of Alabama and portions of Georgia, accompanied the development and movement inland of this disturbance. The LOW moved east-northeastward, passing across the Georgia coast line during the evening of the 21st.

In the Chattahoochee-Apalachicola River Basin, heavy rainfall on the 5th–6th, averaging 1.5 inches in the upper reaches to more than 3 inches in the lower basin, produced moderate rises at all stations and a large rise at Blountstown, Fla. The heavy to excessive rains between the 17th and 21st produced unusually high stages in most of the basin. The total rainfall in the latter period averaged 4 to 6 inches over upper and middle portions of the Chattahoochee and Flint Rivers, with more than 10 inches over a small area to the north and east of Columbus, Ga. At Columbus and at Eufaula and Columbia, Ala., on the Chattahoochee and at Albany and Bainbridge, Ga., on the Flint River, the highest stages since 1929 occurred. Damages amounted to nearly $75,000.

Moderate flooding took place in the Conecuh River, exceeding flood stage by about 5 feet in the upper and by about 3 feet in the lower portion of the river. The Pea and Choctawhatchee had pronounced rises although flooding occurred only in the lower part of the Choctawhatchee River where flood stage was exceeded by about 1 foot. The average rainfall for the period 17th–21st was about 6 inches over these basins. The total losses from these floods have been estimated at $10,000.

The Alabama River system rose to high flood proportions throughout most of the basin, approaching within about 3.5 feet of the highest stages of record in the lower Alabama River. The losses from the overflow have been estimated at about $235,000. In the area of heaviest rainfall, much damage resulted from local washing and flooding from flash rises in small streams. This damage affected fields, roads, and small bridges, but for the most part is not included in the above total.

Precipitation for the 48 hours ending on the morning of March 21 in the Alabama River watershed averaged from 2.5 to 3 inches in the Coosa Basin above Gadsden, Ala., and 3.5 to 4 inches between Gadsden and Childersburg, Ala., including the Cahaba Basin. From Childersburg to Montgomery, Ala., including the Tallapoosa Basin, the 48-hour amounts ranged from 4 to 5 inches, and below Montgomery, 5 to 8 inches, with the greatest amount 8.4 inches at Haynesville, Ala.

A pronounced rise occurred in the Tombigbee River system from heavy rainfall in the upper basin on March 11–12. The upper Tombigbee exceeded flood stage by 0.3 foot at Aberdeen, Miss., on the 15th, and the Black Warrior at Tuscaloosa, Ala., crested at 51.2 feet (flood stage 47 feet) on the 14th. The Warrior receded until March 17, when additional rains caused another rise at Tuscaloosa. Further rains, of greater intensity, on March 20–21, over the Warrior and the lower Tombigbee basins increased the rate of rise.

The precipitation during the latter period ranged from about 2.5 inches in the upper Warrior Basin to over 7 inches at Lock No. 1, on the lower Tombigbee, of which 6.65 inches occurred during the 24 hours ending on the morning of the 21st.

The flooding was light in the extreme upper Tombigbee, but increased in severity in the lower Black Warrior and lower Tombigbee Rivers. The crest stages in the Tombigbee below Demopolis, Ala., were generally 6 feet or more below the highest stages of record. The damages from the flooding totalled about $65,000.

The following is a report, submitted by the official in charge, Weather Bureau office, Meridian, Miss., of the floods that occurred in the Pearl and Pascagoula River basins:

> While the preceding month was dry the soil became soaked from rains falling during the first 15 days of March and some rises had been registered; therefore, considerable damage resulted from the high waters caused by the widespread heavy rains from the 16th to the 26th. The average rainfall in the Pearl River Basin, comprising approximately 6,000 square miles of territory, was 10½ inches, or roughly six and one-half billion tons of water. The Chickasawhay Basin, draining a territory of a little over 6,600 square miles received about 10.2 inches of rain.
>
> The greatest rainfall was in the Leaf River area, covering about 3,000 square miles, where the average rainfall was 12¾ inches, almost 70 percent of which fell in a period of 5 days, from the 17th to the 21st. The run-off from the Chickasawhay and Leaf Rivers began to be felt in the Pascagoula River on the 20th and the waters rose steadily until the 25th to the 28th when they commenced to recede, although the river was above flood stage to the end of the month. In the Bogue Chitto River drainage basin very heavy rains occurred from the 17th to 21st and the stage at Franklinton, La., reached 18.3 feet on the 22d. This is 1.4 feet higher than the previous record crest of 16.9 on April 9, 1938.
>
> In the upper reaches of all streams little damage was caused.

Practically no action had been taken in regard to starting spring crops and much high ground was easily accessible to livestock as the waters rose. In the area nearer the mouth of rivers the loss was considerable. There are many head of livestock feeding in the Pascagoula and Pearl River lowlands. About $50,000 worth of livestock was lost by drowning, and other property, including highways and bridges, amounting to possibly $60,000, was damaged.

Upper Mississippi Basin.—During the latter part of March, melting snow in the tributaries in Minnesota and Wisconsin below Lake Pepin produced floods in the Root, Zumbro-Whitewater and Trempealeau Rivers. The floods were not severe and agricultural damage was negligible at this early season. Slight damage resulted to pastures, highways, and bridges.

A moderate flood in the lower Rock River in Illinois resulted from moderately heavy rain on March 15–16. The rains, combined with moderating temperatures, served to reduce the heavy snow cover in Wisconsin and northern Illinois and increase the run-off. The river crested near Moline, Ill., at 13.4 feet on March 20. The high stage was increased somewhat by ice jams forming near the mouth of the river.

A light flood in the Illinois River from March 16 to the end of the month caused no material damage.

Missouri Basin.—Rapid melting of low-altitude snow in Montana and North Dakota during the latter part of March produced destructive floods in the upper Missouri River tributaries. The following reports on the floods are submitted by the officials in charge at the Weather Bureau offices indicated:

HELENA, MONT.

Rapidly melting snows during the last 10 days in March caused considerable damage from the 25th to the 31st. Two lives were lost, and considerable livestock drowned. Total aggregate property loss probably exceeded $75,000.

In the vicinity of Helena, Lewis and Clark County, small creeks went out of bounds damaging secondary and feeder roads, small bridges, and culverts. One person was drowned near Helena in a flooded coulee on March 28. Basements of a few houses in Helena were flooded.

In the vicinity of Havre, Hill County, and extending eastward through the Milk River valley, heavy damage was done to highways and valley farm lands by the flooded waters of Milk River and its tributaries. One band of sheep, valued around $10,000, was drowned and a man was drowned in Wayne Creek, near Harlem, Blaine County, when his car plunged off the road into the flooded creek, on March 31.

Much damage was done throughout the district by the unusually heavy and rapid runoff. The damage was scattered and locally of minor value, and cannot be estimated with any near adequacy.

BISMARCK, N. DAK.

Snow fell almost continuously over the entire State of North Dakota from March 14 to March 17. The snow was blown into huge drifts, many of them 10 to 15 feet deep so it was hard to determine the average snowfall or the water content of the snow. However, many observers remarked that it was the heaviest snowfall ever experienced in their respective localities and as temperatures were not low during the blizzard the water content of this very fine, hard packed snow was high.

From March 22 to 31, high temperatures and much sunshine prevailed and the snow melted rapidly. The ground was frozen and a previous snow melting had coated the ground with ice so there was more runoff than usual. By March 24, the Cannonball and Heart Rivers were running very high over the western reaches. Severe flooding occurred, beginning on the 24th from Glen Ullin, N. Dak., westward in the Heart River Basin.

The Cannonball, Heart, Knife, and Little Missouri Rivers, as well as the smaller streams in western North Dakota, were running bankful by the 23d. On the 25th, old timers west of Mandan, N. Dak., reported the Heart River higher than they had ever seen it. On the 26th the water began running into the city of Mandan and serious flooding occurred; in some of the lower parts of the city the water was nearly 10 feet deep.

The water in the Heart River and in Mandan began to recede on March 28. About $600,000 damage occurred in Mandan, mostly to stored grain, personal and business property, and to highways and railroads.

U. S. Highway No. 10 was closed for nearly 2 weeks and main-line trains could not run west for 2 days. Trains from Mandan to Killdeer did not operate from March 24 until March 29 when partial service was restored. In some cases the damage was so great that service was still not resumed on April 15.

The Knife, Cannonball, and Little Missouri Rivers also began dropping slowly on the 28th. The greatest damage, about $125,000, occurred on the Cannonball River due to the flooding in Mott, N. Dak., where about 500 families had to be evacuated. About 500 people in Beulah on the Knife River also had to leave their homes due to flooding, with an estimated damage of $25,000. Damage along the Little Missouri River was also about $25,000, mostly to livestock and feed.

The Missouri River was near flood stage from Williston to below Elbowoods beginning March 27 and considerable flooding occurred from the 29th to the 31st in the Williston to Washburn area. The losses along the Missouri during March were slight.

Floods also occurred from Sanish to Washburn on April 1 to April 2 and floods occurred between Bismarck and Washburn from April 1 to April 4, inclusive. During this period the river at Bismarck averaged 3 feet above flood stage and houses and hay stacks were under water for this entire period. More water flowed past Bismarck during this period than in any previous flood on record. About $150,000 damage occurred along the Missouri River to houses and crops, with the greatest damage between Bismarck and Sanger 25 miles north of Bismarck.

SIOUX CITY, IOWA

During the night of March 2–3 an ice gorge formed about 10 miles below Yankton, S. Dak., which gorge held solid until March 25. It was said to be the largest gorge in that vicinity since 1916. The water backed up causing a stage of 12.25 on March 13 and 13.3 on March 23. Slight overflow resulted but no damage of consequence.

Similarly, the night of March 1–2 an ice gorge formed about 5 or 6 miles below the Geddes, S. Dak., gage. A stage of 15.03 resulted on March 14, but only slight overflow resulted with no damage. On March 11 the gorge was reported as having a head of 6 feet.

About March 27 serious ice and flood conditions developed in the Bismarck, N. Dak., area, with tributaries the highest ever observed. In the meantime a phenomenal ice gorge developed some distance below the Mobridge, S. Dak., gage which caused a rapid rise due to the backwater and caused extensive overflow in the Mobridge area. A stage of 19.55 was recorded at 12.45 p. m. on March 28, at which time the gorge broke and passed downstream. This stage was the highest ever recorded at Mobridge and no doubt the highest ever observed at Mobridge by any residents.

Melting snows caused high water in the James River beginning about March 24 and continued into April. A stage of 13.9 was reached at Huron, S. Dak., on March 30. Although this was 2.9 feet above flood stage no flood loss was sustained since only farmland was affected and the season early.

The flood conditions which developed in and above the Bismarck area during the last few days of March caused the highest stages on record on the Missouri River at Mobridge, Pierre, Chamberlain, and Geddes, and the highest stage since 1881 at Yankton, S. Dak., and Sioux City, Iowa. Much farmland was flooded, as well as part of Fort Pierre, S. Dak., and damages will be extensive. A more complete report will be given later as soon as data are available.

Ohio Basin.—A flood developed in the lower Ohio River and tributaries during the month. Flood stage was not reached above Point Pleasant, W. Va., but the flood increased in severity from that point downstream. At Cincinnati, the crest was 59.9 feet on March 23, about 1 foot under the flood of last January, but from Louisville downstream, the March flood exceeded the January flood by several feet. Louisville crested at 65.1 feet against 62.7 feet in January, Evansville, 45.2 feet against 44.3 feet, and Cairo, 49.65 feet against 48 feet.

Rains were more or less general over the middle and lower portions of the Ohio watershed from March 10 to 20, being heaviest on the 18th and 19th. A description of the meteorological conditions during the latter period is given under the discussion of the floods that occurred in the East Gulf of Mexico drainage.

The earlier rains produced a moderate rise in the Ohio and the lower river was approaching flood stage when the heavy rains of March 18–19 began. These rains ranged from 2.5 to 4 inches in the vicinity of Cincinnati and from 4 to 6 inches in the Louisville area. At Louisville 5.8

inches of rain was recorded, establishing a new 24-hour record at that place. In the central portion of the Cumberland River basin, several stations reported 4 to 5.5 inches of rain in the 12 hours ending at 7 a. m. of the 19th.

In general, the rains of the 18th–19th were heaviest in about the lower two-thirds of the Ohio River basin and were concentrated near the main river. The effect of these excessive rains was a very rapid rise in the middle portion of the Ohio River and an almost simultaneous crest in the river from near Maysville, Ky., to near Leavenworth, Ind., a distance of over 200 miles.

Most of the tributaries from the Scioto and Licking Rivers downstream, except for the Tennessee River, were in high flood.

Pacific Slope drainage.—Heavy rains occurred on March 3–4 over the coastal and mountain areas of southern California which resulted in relatively minor floods in Altadena, Sierra Madre, and Eaton Canyon. Peak intensities of rainfall were recorded near midnight of March 3, the values reaching as high as 2.5 inches per hour at some points in the foothills north of Pasadena.

Streams in Fresno, Kern, Kings, and Tulare counties flooded from heavy rains in the mountain and foothills areas on the 9th and 10th, and again on the 17th and 18th. These rains were of cloudburst proportions.

The upper San Joaquin River rose considerably but did not flood. Kings River passed flood stage on March 9–10 with only minor damage. The Kaweah, Tule, and Kern Rivers, Deer Creek and other streams in that area flooded considerably causing much damage.

The overflow from these streams raised the level of Tulare Lake to near the top of the levees. Wave action caused breaks in the levees and flooding of 28,000 acres of agricultural lands.

The following report on the floods in the Sacramento Basin is submitted by the Weather Bureau office, Sacramento, Calif.:

The floods of early March 1943 in the Sacramento and San Joaquin River Valleys rank with the lesser floods of recent years, but its meteorological and hydrologic causes provide an excellent example of flood development to near critical stages as the result of what would appear to be an unimportant series of minor storms.

The month of February was marked by occasional periods of light rain and by warm weather conducive to snow melting from the mountain snow pack. Except for a few slight fluctuations, the rivers continued a slow recession until about March 5. On this date stages in the valley were moderately high and the ground was moist.

On March 4 a warm unstable Polar Pacific air mass moved over the valley and from March 4 to 8 a series of weak, diffused, occluded fronts brought light rain at intervals. An extremely unstable air mass, under the influence of strong westerly winds aloft, brought very heavy showers throughout the eastern foothills of the lower Sacramento and San Joaquin Valleys on the evening of March 9. The showers were extremely intense and quite general in the foothills area. The cloudburst rains occurred just as tributary streams were nearing crests from the earlier rains. Very little rain occurred north of the Feather River basin or in the drainage on the western side of the valley.

Crests were not unusually high at tributary stations, but the prolonged duration of moderately high flows filled the channel storage and caused stages to build up in the lower reaches of the rivers. It was necessary to open 10 gates at Sacramento Weir to hold the river in the vicinity of Sacramento below the flood stage of 29 feet. At H Street Bridge on the American River near Sacramento a crest of 41.3 feet caused considerable flooding. This stage was only 1.2 feet less than the crest in January of this year, although the crest stage at Folsom was 5.5 feet less and the peak discharge at Folsom only slightly more than half as much as in the January flood.

The Mokelumne River at Bensons Ferry reached a crest of 16.4 feet, which is 0.9 foot higher than any previous record. This resulted from the combined effect of long continued moderately high stages on the Cosumnes River, and abnormal contributions from lesser creeks rising in the foothills, notably Dry and Deer Creeks.

The total losses in the Sacramento Basin have been estimated at about $235,000.

FLOOD-STAGE REPORT FOR MARCH 1943

[All dates in March unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ST. LAWRENCE DRAINAGE					
Lake Michigan					
Red Cedar:	*Feet*			*Feet*	
Williamston, Mich	7	16	18	8.0	16
East Lansing, Mich	8	16	18	9.3	17
Cass: Vassar, Mich	14	16	18	16.9	17
Grand:					
Lansing, Mich	11	17	17	11.3	17
Ionia, Mich	21	16	19	22.4	17
Lowell, Mich	15	17	20	16.9	18
Lake Huron					
Shiawassee: Owosso, Mich	7	16	17	7.7	16
Flint: Columbiaville, Mich	10	16	19	11.2	17
Lake Erie					
St. Marys: Decatur, Ind	13	16	21	15.8	20
St. Joseph:					
Fort Wayne, Ind	12	16	21	13.8	17
Montpelier, Ohio	10	16	20	11.9	17–18
Maumee: Fort Wayne, Ind	15	17	21	16.6	18
Sandusky: Upper Sandusky, Ohio	13	20	20	13.0	20
ATLANTIC SLOPE DRAINAGE					
Connecticut: White River Junction, Vt	18	13	13	[1] 18.3	13
		18	21	[1] 18.6	19
James:					
Bremo Bluff, Va	19	15	15	19.0	15
Columbia, Va	10	14	23	18.5	15
Roanoke: Williamston, N. C	10	11	15	10.5	13
		23	([2])	11.0	28–31
Neuse:					
Neuse, N. C	14	8	9	14.9	9
Smithfield, N. C	13	7	11	14.5	10
Goldsboro, N. C	14	12	12	14.0	12
Cape Fear: Lock No. 2, Elizabethtown, N. C	20	8	11	25.9	9
		23	25	23.1	24
Pee Dee:					
Cheraw, S. C	30	7	8	30.8	8
Mars Bluff Bridge, S. C	17	9	14	18.8	11–12
		23	([2])	19.6	27
Poston, S. C	18	14	16	18.2	15
		27	Apr. 2	19.8	30–31
Saluda: Pelzer, S. C	6	20	24	7.0	22
Broad: Blairs, S. C	14	21	23	16.7	22
Savannah:					
Butler Creek, Ga	21	22	24	23.8	23
Burtons Ferry, Ga	15	11	13	15.7	12
		23	([2])	20.4	26
Clyo, Ga	11	11	([2])	18.5	29
Ogeechee:					
Midville, Ga	6	23	27	7.2	26
Dover, Ga	7	11	([2])	9.3	29
Ocmulgee:					
Macon, Ga	18	19	19	18.2	19
		21	23	22.7	22
Hawkinsville, Ga	25	23	27	28.4	25
Abbeville, Ga	11	22	([2])	16.7	27
Lumber City, Ga	15	28	([2])	17.7	[2] 31
Oconee:					
Milledgeville, Ga	20	21	24	29.0	22
Dublin, Ga	21	23	28	25.2	25
Mount Vernon, Ga	16	25	([2])	19.1	28
Altamaha:					
Charlotte, Ga	12	10	19	13.7	15
		22	([2])	22.0	30
Everett City, Ga	10	29	([2])	------	------
EAST GULF OF MEXICO DRAINAGE					
Chattahoochee:					
West Point, Ga	19	21	22	20.3	22
Columbus, Ga	34	21	23	41.2	22
Eufaula, Ala	40	19	19	[3] 41.5	19
		21	25	55.4	23
Columbia, Ala	42	22	26	49.5	24
Flint:					
Montezuma, Ga	20	22	25	22.6	24
Albany, Ga	20	21	30	29.8	25
Bainbridge, Ga	25	25	([2])	30.4	28–29
Apalachicola:					
River Junction, Fla	20	22	30	25.8	27
Blountstown, Fla	15	5	([2])	23.5	27
Conecuh:					
River Falls, Ala	35	21	25	40.5	23
Brewton, Ala	17	23	28	20.5	26
Choctawhatchee: Caryville, Fla	12	23	29	13.1	26
Oostanaula:					
Resaca, Ga	22	22	25	24.9	23
Rome, Ga	25	21	24	20.0	23
Etowah: Cartersville, Ga	18	20	22	25.3	22

See footnotes at end of table.

FLOOD-STAGE REPORT FOR MARCH 1943—Continued

[All dates in March unless otherwise specified]

River and station	Flood stage	Above flood stages—dates From—	Above flood stages—dates To—	Crest Stage	Crest Date
	Feet			Feet	
Coosa:					
Mayos Bar Lock, Ga	28	21	25	32.2	23
Gadsen, Ala	20	21	29	23.4	24
Lock No. 4, Lincoln, Ala	17	21	25	19.0	22
Childersburg, Ala	20	21	23	21.0	22
Wetumpka, Ala	45	21	25	48.9	22
Cahaba:					
Centerville, Ala	23	20	23	26.9	21
Marion Junction, Ala	36	24	24	36.0	24
Alabama:					
Montgomery, Ala	35	20	29	51.0	23
Selma, Ala	45	22	29	52.6	25
Millers Ferry, Ala	40	20	Apr. 3	52.9	27-28
Black Warrior:					
Lock No. 10, Tuscaloosa, Ala	47	20	23	55.6	22
Lock No. 7, Eutaw, Ala	35	14	31	49.9	25
Tombigbee:					
Aberdeen, Miss	34	15	15	34.3	15
Gainesville, Ala	36	20	28	45.0	23
Lock No. 4, Demopolis, Ala	39	16	Apr. 3	56.8	27
Lock No. 3, Whitfield, Ala	33	15	Apr. 5	57.0	27
Lock No. 2, Pennington, Ala	46	18	Apr. 4	58.3	28
Lock No. 1, Salitpa, Ala	31	18	Apr. 7	39.4	29
Leaf: Hattiesburg, Miss	18	21	24	23.7	22
Chickasawhay:					
Enterprise, Miss	20	21	24	25.6	23
Shubuta, Miss	30	21	27	33.6	26
Pascagoula: Merrill, Miss	22	22	Apr. 1	27.0	25
Bogue Chitto: Franklinton, La	11	20	24	18.3	22
Pearl:					
Edinburg, Miss	20	22	28	23.3	24
Jackson, Miss	18	21	Apr. 7	28.5	30
Monticello, Miss	15	20	Apr. 5	19.7	21
Columbia, Miss	17	20	31	21.9	22
Pearl River, La	12	9	14	13.0	12
		20	(2)	17.3	24
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Zumbro: Theilman, Minn	36	26	26	37.9	26
Whitewater: Beaver, Minn	6	25	26	6.4	25
Rock: Moline, Ill	10	15	(2)	13.4	20-21
Illinois:					
Morris, Ill	13	16	18	15.6	17
Peru, Ill	17	16	21	18.6	17
Havana, Ill	14	23	31	14.6	27
Beardstown, Ill	14	24	Apr. 2	14.8	29
Mississippi:					
Quincy, Ill	14	9	10	14.5	9
Hannibal, Mo	13	6	11	17.2	10
		19	21	13.4	20
Louisiana, Mo	12	3	14	15.7	11
		20	22	12.2	20-21
Missouri Basin					
James: Huron, S. Dak	11	26	Apr. 5	13.9	30
Missouri:					
Elbowoods, N. Dak	17	27	(2)		
Mobridge, S. Dak	16	27	28	[4] 19.6	28
Geddes, S. Dak	15	14	14	15.0	14
Yankton, S. Dak	12	13	13	[4] 12.2	13
		23	23	[4] 13.3	23
Ohio Basin					
Allegheny: Olean, N. Y	10	17	17	10.0	17
Tygart: Dailey, W. Va	9	13	14	9.9	14
West Fork: Clarksburg, W. Va	5	20	20	6.1	20
Muskingum:					
Lock No. 10, Zanesville, Ohio	25	20	20	26.0	20
Lock No. 7, McConnelsville, Ohio	22	20	21	23.8	21
Little Kanawha:					
Glenville, W. Va	23	20	20	25.5	20
Creston, W. Va	20	20	21	23.6	20
Hocking: Athens, Ohio	17	20	22	20.4	21
Olentangy: Delaware, Ohio	9	20	20	10.6	20
Scioto:					
LaRue, Ohio	11	17	18	12.9	17
		19	21	13.4	20
Prospect, Ohio	10	18	22	11.8	21
Circleville, Ohio	14	17	22	20.8	21
Chillicothe, Ohio	16	19	23	23.8	21
Piketon, Ohio	15	17	[3] 25	26.9	21
Little Miami: Kings Mills, Ohio	17	19	21	24.2	19
South Fork of Licking: Cynthiana, Ky	20	19	20	21.2	19
Licking: Falmouth, Ky	28	19	22	37.0	20
Whitewater: Brookville, Ind	20	19	20	22.4	19
Great Miami: Middletown, Ohio	15	19	21	17.2	19
Kentucky:					
Jackson, Ky	28	19	20	31.8	20
Lock No. 4, Frankfort, Ky	31	20	22	31.8	20
Barren: Bowling Green, Ky	28	19	23	34.8	21
Rough: Dundee, Ky	25	13	24	26.6	14
Green:					
Munfordville, Ky	28	14	15	29.1	15
		19	23	40.0	21
Lock No. 6, Brownsville, Ky	28	19	25	38.8	22
Lock No. 4, Woodbury, Ky	33	13	27	45.8	23
Lock No. 2, Rumsey, Ky	34	16	Apr. 6	43.1	28
West Fork of White:					
Anderson, Ind	10	16	21	12.9	18
Elliston, Ind	18	18	24	23.2	22
Edwardsport, Ind	12	17	28	20.6	21

FLOOD-STAGE REPORT FOR MARCH 1943—Continued

[All dates in March unless otherwise specified]

River and station	Flood stage	Above flood stages—dates From—	Above flood stages—dates To—	Crest Stage	Crest Date
	Feet			Feet	
East Fork of White:					
Seymour, Ind	14	17	23	18.8	20
Williams, Ind	10	19	27	20.0	23
Shoals, Ind	25	20	27	31.4	24
White:					
Petersburg, Ind	16	17	31	24.1	25
Hazleton, Ind	16	18	Apr. 1	25.8	26
Wabash:					
Bluffton, Ind	10	18	20	11.0	19
Wabash, Ind	12	17	21	14.0	17
				14.3	20
Lafayette, Ind	11	17	23	16.7	20
Covington, Ind	16	18	24	19.8	22
Terre Haute, Ind	14	19	26	16.0	23
Mt. Carmel, Ill	17	20	Apr. 1	22.6	27
New Harmony, Ind	15	23	Apr. 1	18.4	29
Cumberland:					
Celina, Tenn	28	14	25	42.3	22
Lock No. 5, Lebanon, Tenn	45.5	18	26	48.2	20-21
Nashville, Tenn	40	19	25	42.6	20
Lock A, Neptune, Tenn	40	19	26	44.3	21
Clarksville, Tenn	46	19	27	51.1	21
Lock F, Eddyville, Ky	50	18	Apr. 2	59.4	26-27
French Broad: Asheville, N. C	6	21	21	6.0	21
Ohio:					
Point Pleasant, W. Va	40	20	23	43.6	21
Dam No. 28, Huntington, W. Va	50	21	23	52.3	22
Dam No. 29, Ashland, Ky	51	20	24	56.4	22
Dam No. 30, near Greenup, Ky	52	20	24	57.7	22
Portsmouth, Ohio	50	20	24	57.2	22
Dam No. 32, Vanceburg, Ky	53	21	24	57.7	22
Dam No. 33, Maysville, Ky	50	20	25	57.6	22-23
Dam No. 35, New Richmond, Ohio	48	20	26	55.6	23
Dam No. 36, Brent, Ky	52	20	26	59.5	23
Cincinnati, Ohio	52	19	26	59.9	23
Dam No. 37, Fernbank, Ohio	50	19	26	58.9	22-23
Dam No. 38, Grant, Ky	51	19	26	58.6	23
Dam No. 39, Markland, Ind	48	20	26	53.8	23
Madison, Ind	46	20	27	52.9	23
Louisville, Ky. (upper gage)	28	19	28	38.0	23-24
Louisville, Ky. (lower gage)	55	19	28	65.1	23-24
Dam No. 43, Evans Landing, Ind	57	20	28	66.5	23
Dam No. 44, Leavenworth, Ind	53	19	29	65.6	23
Dam No. 45, Addison, Ky	47	19	29	56.1	23-25
Tell City, Ind	38	18	30	47.5	24
Dam No. 46, Owensboro, Ky	41	19	30	46.1	25
Dam No. 47, Newburgh, Ind	38	18	Apr. 2	47.7	25-26
Evansville, Ind	37	18	Apr. 2	45.2	26
Dam No. 48, Henderson, Ky	38	19	Apr. 3	48.0	26
Mt. Vernon, Ind	35	19	Apr. 4	46.3	27-28
Dam No. 49, Uniontown, Ky	37	19	Apr. 4	48.8	28-29
Shawneetown, Ill	33	18	Apr. 5	49.6	29
Dam No. 50, Fords Ferry, Ky	34	18	Apr. 6	52.4	29
Dam No. 51, Golconda, Ill	40	21	Apr. 4	48.6	29-30
Paducah, Ky	39	21	Apr. 4	46.1	30
Dam No. 52, Brookport, Ill	37	19	Apr. 6	48.0	30
Dam No. 53, Grand Chain, Ill	42	20	Apr. 6	52.1	30-31
Cairo, Ill	40	20	Apr. 7	49.65	31
Red Basin					
Little Missouri: Boughton, Ark	20	13	15	21.5	14
Saline: Benton, Ark	20	13	13	20.0	13
Ouachita: Camden, Ark	26	14	23	32.4	18
		28	(2)		
Sulphur:					
Hagansport, Tex	36	13	17	40.4	13
		26	30	38.6	26
Naples, Tex	22	15	23	27.6	17
		31	(2)		
Lower Mississippi Basin					
Big Lake Outlet: Manila, Ark	10	22	Apr. 7	11.9	27-30
St. Francis: St. Francis, Ark	18	26	29	18.4	27-28
Tallahatchie: Swan Lake, Miss	26	16	(2)	29.0	21-22
Mississippi:					
New Madrid, Mo	34	23	Apr. 7	38.8	Apr. 1
Memphis, Tenn	34	31	Apr. 7	35.2	Apr. 5
WEST GULF OF MEXICO DRAINAGE					
Elm Fork of Trinity: Carrollton, Tex	6	25	27	10.4	25
East Fork of Trinity: Rockwall, Tex	10	13	16	12.6	15
		25	29	15.0	26
Trinity:					
Dallas, Tex	28	25	28	34.5	26
Trinidad, Tex	28	27	(2)	33.8	31
PACIFIC SLOPE DRAINAGE					
San Joaquin Basin					
Kings: Piedra, Calif	10	9	9	10.6	9
		10	10	10.6	10
Mokelumne: Bensons Ferry, Calif	12	9	13	16.4	11
Sacramento Basin					
Sacramento: Knights Landing, Calif	30	10	13	30.4	11-12

[1] Stage greatly affected by ice jam.
[2] Continued into April.
[3] Estimated.
[4] Ice gorge below gage.

CLIMATOLOGICAL DATA

CONDENSED CLIMATOLOGICAL SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS

[For description of charts, see REVIEW, January 1942, p. 15]

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Section	Temperature								Precipitation					
	Section average	Departure from the normal	Monthly extremes						Section average	Departure from the normal	Greatest monthly		Least monthly	
			Station	Highest	Date	Station	Lowest	Date			Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	54.6	−1.4	Selma	86	19	Huntsville	7	4	9.87	+4.12	Union Springs	19.68	Athens	4.47
Arizona	53.0	+1.5	Mohawk	100	31	Bright Angel Ranger Station.	0	19	1.32	+.26	Bright Angel Ranger Station.	4.61	2 stations	T
Arkansas	46.9	−5.6	4 stations	84	[1] 29	Siloam Springs	−6	3	5.66	+1.04	Wabash	10.61	Siloam Springs	2.15
California	52.3	+.9	Greenland Ranch	96	28	Soda Springs	0	16	4.82	+1.10	Springville (near)	23.47	El Centro	.16
Colorado	32.8	−1.8	Holly	92	29	Columbine	−46	2	1.31	−.01	Wolf Creek Pass	8.92	Manassa	T
Florida	65.1	−.1	Davenport	94	20	Mount Pleasant	17	4	4.43	+1.34	Mount Pleasant	11.30	Big Cypress	.12
Georgia	54.0	−2.1	3 stations	83	[1] 13	Blairsville	3	4	7.90	+2.98	Columbus	15.69	Blackbeard Island	2.81
Idaho	32.0	−3.8	2 stations	81	28	Island Park Dam	−35	[1] 2	1.94	+.17	Roland	6.67	Howe	T
Illinois	37.0	−3.8	4 stations	83	[1] 30	Morris	−19	8	2.75	−.37	Shawneetown	11.25	Golden	.88
Indiana	37.6	−3.0	Kelly Hill	88	31	Goshen	−19	8	4.67	+.98	Tell City	11.64	Albion	1.46
Iowa	31.0	−3.6	Hawarden	90	30	Decorah	−19	11	1.51	−.21	Anamosa	2.86	Sloan	.30
Kansas	39.5	−3.9	Syracuse	94	29	Tribune	−17	2	.85	−.57	Pittsburg	4.09	Cimarron	.12
Kentucky	43.0	−3.6	4 stations	80	[1] 19	Pippapass	−5	4	7.62	+2.90	Greensburg	13.23	Grayson	3.70
Louisiana	57.6	−2.9	2 stations	86	[1] 15	Arcadia	10	3	7.68	+2.95	Talisheek Tower	17.42	Monroe	3.17
Maryland-Delaware	42.8	+.2	Takoma, Md	84	31	Mount Savage Summit, Md.	−6	4	3.56	−.07	Fort George G. Meade, Md.	5.72	Cumberland, Md	1.86
Michigan	25.7	−3.9	Wayne	82	31	Fife Lake (near)	−45	3	2.82	+.74	Alpena (near)	4.82	Saginaw	1.42
Minnesota	19.9	−6.6	2 stations	85	30	Warroad	−40	5	1.37	+.17	Mora	2.52	Grand Marais	.30
Mississippi	53.9	−3.0	Columbia	85	12	Corinth	9	3	8.57	+2.81	Columbia	16.72	Fulton	5.16
Missouri	39.7	−4.2	Tarkio	87	30	Goodland	−22	3	2.63	−.53	Caruthersville	7.36	Grant City	.40
Montana	24.0	−7.2	2 stations	83	29	2 stations	−42	[1] 2	.93	−.04	Mystic Lake	5.48	Dillon	.06
Nebraska	32.4	−4.1	3 stations	94	30	Nenzel (near)	−31	7	.77	−.33	Hartington	2.07	2 stations	.10
Nevada	43.5	+2.9	Las Vegas	94	28	Sheldon	1	15	1.25	+.26	Spooners Station	9.68	Coaldale	.00
New England	30.1	−2.0	Norwalk, Conn	71	26	Lake Frontiers, Maine	−40	9	3.09	−.58	Machias, Maine	5.72	Newport, Vt	1.24
New Jersey	39.5	+.3	Bridgeton	85	31	Charlotteburg	−10	9	3.01	−.76	Atlantic City	4.43	Layton	.71
New Mexico	44.0	+.3	Melrose	93	29	2 stations	−8	[1] 16	.54	−.23	Aspen Grove Ranch	2.35	15 stations	.00
New York	31.2	−.8	5 stations	80	31	Stillwater Reservoir	−34	9	2.91	−.17	Hoffmeister	5.95	Dannemora	1.24
North Carolina	48.2	−1.7	Greenville	85	[1] 19	Mount Mitchell	−13	3	5.05	+.84	Highlands	8.65	Beaufort	3.08
North Dakota	17.0	−6.8	2 stations	77	[1] 29	Westhope	−30	5	1.23	+.44	Richardton	2.25	Golva	.32
Ohio	37.3	−1.5	do	82	31	Paulding	−13	8	4.44	+1.05	Chilo	7.72	Wauseon	1.72
Oklahoma	45.7	−5.0	Beaver	90	31	Hooker	−7	3	1.99	−.13	Bear Mt. Tower	5.20	Goodwell	.13
Oregon	40.2	−.9	Powers	80	4	2 stations	−11	[1] 1	3.03	+.29	Valsetz	21.41	Huntington	.11
Pennsylvania	37.2	−.4	Phoenixville	85	31	do	−15	9	2.73	−.77	Manada Gap	4.39	Ansonia	1.54
South Carolina	52.5	−2.2	Ferguson	89	13	Caesars Head	3	4	6.09	+2.16	Walhalla	9.81	Kershaw	3.52
South Dakota	25.5	−5.7	Tyndall	96	30	Pine Ridge	−26	7	.74	−.37	Watertown	1.98	2 stations	.10
Tennessee	45.8	−3.6	Tri City Airport	85	18	Rugby	−4	4	6.94	+1.61	Madison College	11.17	Kingport	3.85
Texas	54.8	−3.7	2 stations	100	15	Spur	−3	6	2.04	+.01	Orange	7.86	3 stations	.00
Utah	38.3	−.1	3 stations	84	[1] 28	Moon Lake	−14	2	1.44	+.02	Silver Lake (Brighton)	6.57	Callao	.00
Virginia	44.6	−1.1	Clarksville	89	[1] 20	Big Meadow	−6	4	4.03	+.36	Pennington Gap	6.23	Dahlgren	2.00
Washington	38.9	−2.9	Kennewick	73	27	2 stations	−8	[1] 5	3.96	+.56	Highley Peak	20.45	Kennewick	.08
West Virginia	40.0	−2.3	Martinsburg	85	31	do	−17	4	4.59	+.69	Kermit	9.23	Knobly Mountain	1.90
Wisconsin	23.3	−5.8	Richland Center	80	30	Long Lake	−40	[1] 3	2.17	+.43	Mellen	4.03	Spooner	.78
Wyoming	25.1	−4.7	Torrington	85	29	Moran	−40	[1] 2	1.16	+.02	Grassy Lake Dam	6.00	Powell	T
Alaska (February)	13.4	+5.6	Eklutna	63	26	Tanacross	−63	7	2.59	+.69	Ketchikan	20.70	Eagle	T
Hawaii	68.9	−.3	2 stations	88	[1] 24	Volcano Observatory	43	16	8.26	−.27	Kukui	39.00	Niu Ridge	.15
Puerto Rico	73.7	+.2	Utuado	93	[1] 22	2 stations	51	[1] 24	3.41	+.03	Rio Blanco (1800)	10.48	Yauco	.56

[1] Other dates also.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS

District and station	Elevation of instruments			Pressure, station reduced to mean of 24 hours	Temperature of the air										Mean temperature of the dew-point	Mean relative humidity	Precipitation			Wind					Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month	Number of days with thunderstorms
	Barometer above sea level	Thermometer above ground	Anemometer above ground		Mean max. + mean min. ÷ 2	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range			Total	Departure from normal	Days with 0.01 inch or more	Average hourly velocity	Prevailing direction	Maximum velocity: Miles per hour	Maximum velocity: Direction	Maximum velocity: Date							
	Ft.	Ft.	Ft.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.	
New England					**31.0**	**−0.5**									**70**	**3.45**	**0.0**										**6.4**			
Eastport	75	67	85	30.02	28.4	−0.5	53	27	35	1	4	22	27	19	69	4.37	+.5	12	11.8	w.	34	sw.	5	7	10	14	6.3	19.7	T	0
Greenville, Maine	1,070	6		28.90	20.6	−4.6	54	26	32	−24	9	10	43	15		3.58	+.6	15		nw.				6	12	13			22.8	0
Portland, Maine [1]	103	5	36	30.01	29.6		64	26	38	−10	9	21	39	19	66	2.43	−1.4	9	10.0	n.	31	w.	27	10	8	13	6.1	13.2	.0	0
Concord [2]	289	4	45	29.82	29.2	−1.6	63	26	38	−16	9	20	40	18	65	2.47	−.6	9	8.4	nw.	31	nw.	23	10	7	14	6.4	7.2	.0	0
Burlington [2]	403	11	48	29.66	27.5	−1.6	61	26	35	−5	9	20	30	19	70	1.25	−.8	11	10.9	s.	34	se.	5	3	15	13	6.9	7.9	.0	0
Northfield	876	12	60	29.15	26.0	−.4	58	26	35	−22	9	17	42			1.76	−.8	15	9.6	sw.	30	sw.	18	5	12	14	6.8	14.7	T	0
Boston	124	33	62	29.99	36.0		68	26	44	6	4	28	28	23	63	4.02	+.4	11	12.8	nw.	31	e.	6	8	6	17	6.8	8.0	.0	0
Nantucket	12	10	63	30.11	36.4	+.9	56	25	43	11	4	30	22	30	81	4.57	+.8	15	12.7	sw.	33	ne.	28	8	8	15	6.5	7.2	.0	0
Block Island	26	11	46	30.10	36.0	+.6	56	26	42	9	4	30	21	28	76	3.38	−.4	12	17.2	sw.	43	s.	6	15	4	12	4.9	3.5	.0	0
Providence [2]	159	46	60	29.98	37.2	+1.5	70	26	46	6	4	29	31	25	69	3.74	+.2	11	9.5	n.	30	sw.	5	10	7	14	6.3	10.1	.0	0
Hartford [1]	159	5	44	29.97	34.8		70	26	44	4	4	26	42	24	69	4.54	+.6	11	9.7	n.	27	n.	23	8	7	16	6.6	9.6	.0	0
New Haven [2]	107	74	153	30.04	37.3	+1.6	68	26	46	6	4	29	31	27	75	5.26	+1.2	11	9.7	n.	27	sw.	26	8	7	16	6.6	8.3	.0	0
Middle Atlantic States					**41.7**	**+1.2**									**67**	**3.51**	**+.0.1**										**6.1**			
Albany [1]	97	26	40	30.03	31.4	+1.6	66	26	40	−14	9	23	38	20	66	2.45	−.2	10	11.7	s.	32	w.	2	5	9	17	7.2	10.3	.0	1
Binghamton	871	57	79	29.17	34.4	+1.8	79	31	44	−3	9	24	36	22	70	3.06	+.4	9	7.1	w.	27	w.	7	9	16	6	5.0	5.6	.0	0
New York	314	415	454	29.80	39.6	+1.9	68	26	48	7	4	31	25	26	61	3.86	+.2	12	16.6	n.	52	s.	6	9	8	14	6.1	6.5	.0	0
Harrisburg [1]	374	30	49		40.6	+1.7	83	31	50	8	4	31		27	64	2.69	−.4	12	8.9	w.	38	sw.	16	5	9	17		4.5	.0	1
Philadelphia [2]	114	174	367	30.03	41.3	+.5	79	31	52	7	4	31	37	29	68	2.92	−.5	10	10.3	sw.	31	s.	6	7	8	16	6.6	7.8	.0	0
Reading	323	47	306	29.81	41.0	+.4	82	31	50	7	4	32	42			2.67	−.8	9	13.5	nw.	43	e.	31	6	11	14	6.6	8.8	.0	1
Scranton	805	72	104	29.27	36.2	+.5	77	31	45	0	4	27	36			3.21	.0	11	8.1	sw.	24	sw.	18	5	14	12	6.4	5.0	.0	0
Atlantic City	52	37	172	30.10	41.0	+2.4	70	20	48	10	4	34	29	30	71	4.43	+.8	13	17.6	s.	54	se.	6	7	9	15	6.1	3.8	.0	1
Trenton	190	89	107	29.95	40.4	+1.3	72	26	50	8	4	31	30	27	64	2.28	−1.1	10	10.1	n.	28	n.	23	4	16	11	6.5	4.7	.0	0
Baltimore [2]	123	100	215	30.03	44.6	+2.3	83	31	54	11	4	35	39	30	66	4.38	+.7	12	11.0	sw.	33	sw.	20	7	10	14	6.3	14.7	.0	1
Washington [2]	112	56	100	29.95	45.4	+2.8	82	31	56	11	4	35	42	30	62	4.31	+.6	12	8.7	s.	24	nw.	7	10	8	13	5.9	7.9	.0	1
Cape Henry	18	8	54	30.14	47.2	+.6	82	19	56	21	4	39	36	38	74	3.21	−.7	10	13.8	n.	42	n.	17	12	4	15	5.8	T	.0	1
Lynchburg	686	144	184	29.43	46.4	−.9	81	31	58	12	4	35	43	31	61	4.51	+1.0	15	7.8	nw.	33	sw.	19	11	7	13	5.4	3.3	.0	4
Norfolk [2]	91	80	125	30.08	49.0	+.8	82	19	59	16	4	39	32	37	75	4.18	+.4	10	11.0	ne.	35	s.	6	11	5	15	5.8	.1	.0	3
Richmond [2]	144	11	52	30.01	47.6	+.4	81	31	59	12	4	36	41	33	65	4.49	+.8	10	9.7	sw.	30	sw.	19	11	9	11	5.2	6.0	.0	1
South Atlantic States					**52.9**	**−0.7**									**76**	**5.01**	**+1.3**										**5.7**			
Asheville	2,253	89	104	27.78	44.6	−.3	77	31	56	7	4	33	39	32	71	4.00	.0	14	9.6	nw.	28	nw.	3	11	1	19	6.2	1.1	.0	3
Charlotte [2]	779	63	86	29.32	49.6	−.8	78	31	60	15	4	40	32	38	73	5.08	+.9	17	7.9	sw.	23	s.	20	11	4	16	5.8	.2	.0	2
Greensboro [1]	886	6	56	29.22	46.3		77	19	58	10	4	34	39	36	74	4.46		12	8.9	sw.	27	sw.	19	11	4	16	5.8	1.2	.0	2
Hatteras	11	5	50	30.15	50.7	−1.3	72	20	58	24	4	44	24	45	86	6.09	+1.8	11	15.3	n.	37	n.	21	10	9	12	5.5	T	.0	3
Raleigh [1]	376	27	69	29.76	49.9	+1.0	81	19	62	13	4	38	39	37	70	4.58	+.7	11	10.1	sw.	41	w.	6	11	2	18	5.8	.3	.0	1
Wilmington	72	73	107	30.10	53.6	+.3	81	20	64	20	4	44	32	45	80	4.73	+1.6	10	10.3	sw.	53	s.	6	11	8	12	5.5	T	.0	3
Charleston [2]	48	11	92	30.11	55.5	−1.9	79	19	63	25	4	48	28	47	83	5.49	+2.5	11	10.8	s.	32	s.	6	13	3	15	6.0	.0	.0	3
Columbia, S. C. [2]	347	70	91	29.78	53.6	−1.6	82	19	64	19	4	43	33	44	79	5.12	+1.7	10	8.8	ne.	26	sw.	13	11	7	13	5.7	T	.0	0
Greenville, S. C. [1]	1,040	70	78	29.04	48.8	−1.1	76	31	58	14	4	39	31	37	71	4.43	−.7	16	10.1	sw.	37	ne.	21	12	2	17	5.9	T	.0	3
Augusta [2]	182	62	77	29.94	54.7	−1.3	83	19	65	20	4	45	31	41	66	7.17	+3.1	11	6.1	ne.	22	se.	26	12	4	15	5.8	.0	.0	3
Savannah [2]	65	73	152	30.09	58.9	−.1	84	20	68	26	4	49	30	48	79	4.73	+1.7	8	11.1	e.	33	nw.	3	12	11	8	5.2	.0	.0	4
Jacksonville [2]	43	86	110	30.10	62.4	−.2	86	19	72	25	4	52	32	51	79	3.73	+.8	7	8.9	ne.	35	sw.	6	12	8	11	5.3	.0	.0	4
Florida Peninsula					**69.9**	**0.0**									**77**	**3.24**	**+1.2**										**4.0**			
Key West [2]	21	10	64	30.05	73.4	+.8	84	21	79	55	4	68	19	62	73	2.68	+1.3	9	12.4	e.	40	nw.	21	22	5	4	3.4	.0	.0	3
Miami [2]	25	124	168	30.07	70.1	−.1	83	7	74	43	4	66	31	61	77	3.29	+1.1	6	16.3	se.	36	ne.	29	14	11	6	4.5	.0	.0	1
Tampa [1]	35	5	61	30.08	66.2	−.6	84	19	76	31	4	57	31	57	80	3.75	+1.3	7	11.8	ne.	34	s.	6	17	9	5	4.2	.0	.0	4
East Gulf States					**55.8**	**−2.1**									**75**	**8.33**	**+3.1**										**5.4**			
Atlanta [1]	1,173	5	72	28.90	50.6	−1.4	78	19	60	14	4	41	31	30	72	8.02	+2.6	15	11.1	e.	32	nw.	3	12	2	17	6.1	.4	.0	5
Macon [2]	370	79	87	29.75	54.0	−2.7	82	19	64	18	4	44	32	43	72	7.99	+3.0	11	7.7	s.	22	nw.	3	11	11	9	5.3	.0	.0	5
Thomasville	273	49	58	29.83	60.0	−.2	84	20	72	22	4	48	42			6.69	+2.6	8						7	9	15		.0	.0	5
Apalachicola	35	11	51	30.08	60.1	−1.5	78	21	67	26	4	53	28	52	81	5.37	+1.1	7	10.8	se.	29	s.	6	14	11	6	4.3	.0	.0	7
Pensacola	56	54	79	30.05	59.2	−1.1	78	19	67	24	4	51	31	50	78	7.28	+2.5	11	9.8	se.	26	w.	6	13	8	10	4.8	.0	.0	6
Anniston	741	9			51.8	−.7	80	19	63	12	4	41	35			9.80	+4.2	12		nw.				8	10	13		T	.0	4
Birmingham [2]	700	11	48	29.40	51.8	−3.6	81	19	62	14	3	42	33	40	73	9.35	+3.6	15	9.6	n.	32	se.	26	11	5	15	5.6	T	.0	7
Mobile [2]	57	6	30	30.06	57.8	−1.9	77	18	66	24	4	49	27	49	80	10.34	+4.4	11	8.3	n.	26	n.	3	9	12	10	5.5	.0	.0	9
Montgomery [2]	218	92	105	29.90	55.6	−2.2	85	19	65	21	3	46	25	44	71	12.92	+6.9	13	9.0	n.	22	n.	20	10	5	16	5.8	T	.0	6
Meridian [2]	375	67	92	29.72	54.2	−2.9	81	18	65	15	3	44	36	43	72	8.57	+3.3	13	8.6	s.	24	sw.	19	11	8	12	5.4	T	.0	4
Vicksburg [2]	247	82	102	29.85	55.1	−3.4	82	18	65	17	3	45	32	42	74	6.07	+.5	13	11.1	n.	26	n.	20	12	3	16	5.5	T	.0	6
New Orleans [2]	53	76	84	30.04	59.7	−3.1	83	19	68	29	3	52	25	52	79	7.54	+2.8	8	8.8	se.	19	se.	20	7	12	12	6.1	.0	.0	5
West Gulf States					**54.7**	**−4.4**									**71**	**3.63**	**+0.7**										**6.0**			
Shreveport [1]	249	92	227	29.83	53.4	−3.9	80	30	64	15	3	43	39	43	71	5.94	+1.8	11	11.4	se.	34	s.	15	10	4	17	6.0	.0	.0	4
Bentonville	1,303	12	51	28.73	41.8	−5.5	78	30	53	−2	3	31	35			2.59	−1.4	13	9.0	s.	21	s.	15	8	15	8		1.1	.0	3
Fort Smith	463	57	82	29.60	47.2	−5.4	80	30	57	9	3	37	36	32	60	3.80	+.8	10	8.9	e.	26	s.	15	8	9	14	6.2	T	.0	5
Little Rock [1]	357	94	102	29.74	47.3	−5.7	80	30	57	11	3	37	38	37	72	7.61	+3.0	9	10.1	n.	34	nw.	16	11	6	14	5.7	T	.0	6
Austin [1]	605	11	41	29.41	55.8	−4.9	84	15	68	18	3	44	38	42	64	2.54	+.2	3	12.6	n.	34	n.	6	10	7	14	5.8	.0	.0	1
Brownsville [2]	57	88	96	29.92	66.7	−1.5	89	19	76	34	3	57	40	57	78	.31	−1.3	2	12.7	se.	31	n.	19	5	11	15	6.6	T	.0	0
Corpus Christi [2]	20	11	78	30.00	62.6	−2.4	86	5	71	28	3	54	29	54	78	1.76	+.2	2	14.9	se.	37	s.	15	8	10	13	5.9	.0	.0	2
Dallas [1]	512	6	46	29.52	51.7		83	15	63	11	3	41	36	40	69	4.59	+1.7	8	14.0	n.	46	e.	24	9	7	15	6.1	T	.0	5
Fort Worth [1]	679	35	56	29.35	51.4	−5.3	86	15	62	10	3	41	36	37	63	4.05	+1.7	8	14.6	s.	37	nw.	6	9	8	14	6.1	T	.0	6
Galveston [2]	54	106	114	30.00	58.7	−3.7	77	16	64	27	3	53	27	53	84	3.62	+.9	7	12.0	se.	29	nw.	6	8	11	12	6.0	.0	.0	4
Houston [2]	138	157	190	29.91	59.2	−4.1	80	18	60	21	3	50	32	49	77	3.99	+.5	9	12.6	se.	30	nw.	6	11	3	17	5.9	.0	.0	3
Palestine	510	64	72	29.54	53.6	−5.5	80	29	64	14	3	43	33	40	67	2.91	−.6	12	9.7	s.	29	s.	15	8	8	15	5.9	.0	.0	3
Port Arthur	34	59	134	30.03	58.8		77	29	67	24	3	51	25	50	77	5.59	+2.3	10	15.6	s.	34	s.	15	9	11	11	5.7	.0	.0	5
San Antonio [1]	693	28	59	29.30	58.3	−4.5	87	15	70	21	3	46	34	43	63	1.58	−.3	4	12.0	ne.	42	n.	24	8	10	13	6.1	.0	.0	4
Ohio Valley and Tennessee					**40.9**	**−2.5**									**69**	**6.20**	**+2.0**										**5.8**			
Chattanooga [1]	762	21	54	29.33	47.4	−1.7	77	19	59	9	4	36	38	36	73	7.00	+1.2	14	8.9	s.	31	nw.	13	11	3	17	6.2	T	.0	8
Knoxville [2]	995	66	84	29.09	46.2	−2.5	77	19	58	9	4	34	37	34	70	5.17	+.1	14	9.1	ne.	35	sw.	19	10	11	10	5.5	5.9	.0	5
Memphis [2]	399	78	86	29.70	46.8	−5.5	77	30	57	12	3	37	36	36	70	7.45	+2.2	10	8.5	e.	25	s.	19	11	8	12	5.1	T	.0	4

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure, station reduced to mean of 24 hours	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch or more	Wind: Average hourly velocity	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month	Number of days with thunderstorms
	Ft.	Ft.	Ft.	In.	° F.	° F.	° F.		° F.	° F.		° F.	° F.	° F.	%	In.	In.		Miles								0-10	In.	In.	
Ohio Valley and Tennessee—Continued					40.9	-2.5									69	6.20	+2.0										5.8			
Nashville [1]	546	5	72	29.56	45.4		76	31	57	7	3	34	38	34	68	8.43	+3.3	14	10.2	s.	35	s.	19	11	6	14	5.5	3.1	0.0	4
Lexington	989	6		29.09	41.0	-2.7	76	31	53	3	4	29	39			7.47	+3.2	14		s.				12	5	14	5.5	8.9	.0	1
Louisville [2]	525	106	120	29.60	42.2	-3.2	76	31	52	4	3	33	35	29	67	10.02	+5.6	13	10.5	s.	34	s.	16	14	4	13	5.0	1.5	.0	3
Evansville [1]	431	5	38	29.69	40.2	-4.2	76	31	51	1	3	30	36	29	66	9.46	+5.3	12	10.4	s.	29	s.	2	10	9	12	5.7	2.9	.0	4
Indianapolis [2]	823	98	129	29.25	35.8	-4.2	78	31	47	-6	8	25	35	26	71	3.30		8	12.3	sw.	35	w.	19	11	8	12	5.7	3.1	.0	3
Terre Haute [2]	575	68	149	29.54	38.8		78	31	49	0	3	29	30	27	70	2.98	-.8	9	11.7	s.	33	sw.	4	12	9	10	5.4	4.1	.0	3
Cincinnati [2]	627	11	51	29.48	39.8	-1.1	76	31	50	3	8	30	36	28	70	6.46	+2.6	14	9.1	sw.	28	sw.	16	12	6	13	5.5	5.7	.0	4
Columbus [2]	822	90	110	29.27	38.1	-1.0	76	31	47	1	4	29	34	25	68	4.57	+1.1	10	11.7	s.	46	sw.	16	8	8	15	6.3	4.4	.0	3
Dayton [2]	900	186	213	29.17	37.7	-2.8	75	31	46	0	3	29	31	26	75	5.69	+2.0	11	11.7	sw.	32	s.	4	8	6	17	6.2	4.0	.0	4
Elkins [2]	1,947	61	78	28.07	38.4	-1.6	78	19	50	1	4	27	43	26	69	4.75	+1.0	15	7.4	w.	30	w.	6	8	4	19	6.7	8.5	.0	0
Parkersburg	637	77	84	29.47	40.8	-2.0	78	31	52	-3	4	30	44	26	62	4.08	+.6	14	7.0	se.	30	sw.	19	10	9	12	5.5	5.2	.0	1
Pittsburgh [1]	842	39	54	29.23	37.6	-.6	75	31	47	-1	4	28	36	24	63	3.26	+.2	12	13.1	s.	35	w.	6	5	10	16	6.7	10.6	.0	0
Lower Lake Region					32.8	+0.4									72	2.42	-0.3										6.3			
Buffalo [2]	768	243	280	29.27	30.3	-.8	64	31	38	-3	4	22	31	22	73	2.44	-.1	13	17.7	sw.	72	sw.	6	7	13	11	5.7	10.4	.0	1
Canton	448	10	61	29.60	26.8	-.9	56	26	35	-9	4	18	33	19	76	1.76	-.7	15	11.4	w.	42	sw.	7	3	14	14	7.1	10.4	.0	1
Ithaca	836	77	100		33.9	+2.1	78	31	44	-2	4	24	32			2.61	+.3	10	10.9	nw.	29	se.	6	4	13	14	7.0	8.8	.0	0
Oswego	335	71	85	29.74	31.2	.0	63	26	38	1	9	24	26	21	66	2.13	-.4	14	11.6	w.	37	sw.	7	9	9	13	6.1	11.5	.0	0
Rochester [1]	523	5	69	29.54	31.8	+2.0	73	31	41	-3	4	22	34	23	75	2.59	-.2	13	13.3	w.	57	s.	7	7	11	13	6.4	10.7	.0	0
Syracuse [1]	596	5	51	29.46	32.0	+2.3	66	26	42	-6	9	22	34	23	74	2.70	-.6	13	12.6	sw.	42	sw.	7	3	12	16	7.0	8.6	.0	1
Erie [2]	714	57	81	29.25	35.0	+1.5	76	31	43	3	3	27	31	24	75	2.51	-.1	11	10.1	w.	29	w.	6	8	8	15	6.4	10.8	.0	0
Cleveland [1]	762	27	54	29.30	36.1	+1.6	77	31	46	2	4	26	33	25	70	2.95	+.2	13	13.2	sw.	40	sw.	19	5	10	16	7.1	10.1	.0	1
Sandusky	629	5	67		35.9	+.8	80	31	45	0	8	27	37			2.20	-.5	6	11.1	sw.	32	sw.	17	11	9	11	5.5	5.5	.0	0
Toledo [2]	628	79	87	29.43	33.6	-1.7	80	31	44	-7	8	23	34	25	74	1.98	-.6	7	14.2	sw.	48	sw.	17	17	7	7	4.0	3.1	.0	0
Fort Wayne [1]	857	69	84	29.19	33.5	-2.6	78	31	44	-9	8	23	34	24	73	2.96	-.3	7	11.1	w.	35	w.	17	8	9	14	6.1	3.3	.0	3
Detroit [1]	730	5	78	29.31	33.8	+.8	80	31	43	-1	8	25	34	23	69	2.18	-.2	9	12.2	sw.	43	sw.	17	5	12	14	6.7	2.9	.0	1
Upper Lake Region					24.8	-2.9									76	2.68	+0.6										6.0			
Alpena	609	5	89	29.40	23.1	-2.4	73	31	32	-16	3	14	39	17	80	3.58	+1.6	15	11.9	nw.	32	se.	9	8	9	14	6.4	17.9	T	1
Escanaba	612	51	72	29.39	20.9	-3.3	56	24	30	-13	3	12	26	14	79	2.89	+1.0	11	11.1	s.	31	e.	16	8	11	12	5.8	30.0	.4	2
Grand Rapids [2]	707	70	244	29.32	31.6	-1.8	75	30	40	-5	3	23	33	21	74	2.98	+.5	9	14.0	sw.	47	sw.	17	5	16	10	6.2	11.0	.0	3
Lansing [2]	878	5	90	29.14	30.8	-1.4	78	31	40	-7	8	21	33	22	73	3.02	+.7	8	10.4	sw.	30	sw.	17	6	13	12	6.1	7.0	.0	2
Ludington	637	60	66																											
Marquette	734	44	73	29.24	21.5	-3.3	61	25	29	-13	2	14	28	12	69	3.09	+.8	14	8.9	nw.	26	sw.	17	9	10	12	6.3	20.3	4.2	1
Sault Sainte Marie [1]	614	11	43	29.38	16.8	-3.8	47	31	25	-24	3	8	32	12	82	3.22	+1.5	15	12.8	e.	39	sw.	17	9	7	15	6.4	28.7	1.6	0
Chicago [1]	673	19	38	29.38	32.2	-2.3	78	30	42	-7	8	22	33	23	73	2.47	-.1	9	12.2	sw.	37	sw.	17	6	12	13	6.1	7.8	.0	2
Green Bay	617	109	141	29.40	24.3	-4.3	72	30	33	-12	2	16	30	18	77	1.85	-.2	9	12.1	s.	31	sw.	17	8	12	11	5.7	12.1	.0	1
Milwaukee [1]	681	33	66	29.35	29.0	-1.1	77	30	38	-6	3	20	33	20	70	2.48	+.1	8	15.7	sw.	52	sw.	17	6	13	12	5.9	9.4	.0	1
Duluth	1,133	5	47	28.80	18.0	-5.7	56	25	27	-20	2	9	28	9	82	1.24	-.3	9	14.6	nw.	47	ne.	15	8	12	11	5.6	15.5	T	0
North Dakota					17.6	-4.3									80	0.99	+0.1										6.4			
Fargo [1]	940	5	43	29.02	17.6	-5.1	62	30	27	-13	5	8	36	13	83	.85	-.2	6	14.4	nw.	42	nw.	4	7	11	13	6.2	10.5	T	0
Bismarck [1]	1,677	4	41	28.23	18.6	-3.3	59	31	29	-12	2	8	42	12	77	1.31	+.4	11	12.2	nw.	43	nw.	17	9	8	14	6.1	16.1	T	0
Devils Lake	1,478	11	44	28.44	15.8	-4.0	51	29	25	-17	7	7	32	11	84	.49	-.3	6	10.8	nw.	31	ne.	16	6	9	16	7.0	4.9	T	0
Lemmon, S. Dak	2,602	4	38	27.25	20.8		73	28	32	-16	2	9	45	14	78	.60	-.3	6		nw.				10	10	11		13.2	.0	0
Grand Forks	832	11	71	29.16	14.9		48	30	24	-18	5	5	35	11		1.16		6		nw.				6	11	14		15.8	T	0
Williston	1,878	42	50	28.02	18.2	-4.7	60	28	28	-17	5	8	34	11	77	1.71	+1.0	8	8.6	nw.	30	n.	16	6	13	12	6.2	16.3	T	0
Upper Mississippi Valley					32.4	-4.0									71	2.42	0.0										5.8			
Minneapolis-St. Paul, Minn. [1]	919	32	61	29.05	23.6	-6.0	76	30	32	-11	2	15	32	16	72	.81	-.6	7	11.8	nw.	35	w.	17	7	11	13	6.3	9.8	T	1
Springfield, Minn.	1,025	4	42	28.94	25.0		81	30	35	-7	2	15	37	17	74	1.18		9		nw.				7	12	12		7.8	.0	2
La Crosse [2]	714	11	48	29.30	24.2	-7.3	74	30	34	-11	2	14	42	16	74	1.79	+.2	8	10.8	nw.	35	nw.	4	6	13	12	6.0	13.0	T	2
Madison [2]	974	70	78	29.03	27.6	-3.0	77	30	36	-10	2	19	35	18	74	2.97	+.9	11	10.2	sw.	27	sw.	17	11	9	11	5.6	12.7	.0	1
Charles City	1,015	10	51	29.00	25.4	-5.3	79	30	36	-9	2	15	47			2.32	+.6	8	8.2	se.	30	w.	17	12	8	11	5.2	16.5	.0	1
Davenport [2]	606	66	161	29.46	33.6	-2.5	80	30	43	-1	2	24	34	24	74	1.97	-.3	7	11.5	sw.	32	sw.	30	8	12	11	6.1	6.3	.0	1
Des Moines [2]	860	5	99	29.15	32.2	-3.7	83	30	43	-3	2	22	43	22	70	2.25	+.5	7	12.1	sw.	34	s.	30	11	8	12	5.2	11.5	.0	1
Dubuque	699	60	79	29.34	30.6	-3.4	81	30	40	-6	8	21	35	21	70	2.75	+.7	7	7.6	nw.	21	nw.	4	11	8	12	5.8	5.6	.0	1
Burlington, Iowa [1]	702	6	35	29.35	33.2	-5.7	82	30	44	-5	7	23	36	22	66	1.34	-1.4	7	11.7	s.	34	sw.	30	8	11	12	5.7	6.4	.0	2
Cairo	357	5	99	29.77	43.8	-3.4	76	30	53	7	3	34	35			5.06	+1.3	11	10.6	s.	32	sw.	19	10	8	13	5.7	4.5	.0	4
Peoria [2]	609	11	45	29.48	35.4	-1.6	82	30	46	-11	8	25	35	25	72	2.28	-.4	6	7.9	s.	24	sw.	30	10	9	12	5.6	7.7	.0	1
Springfield, Ill. [2]	636	5	191	29.45	38.0	-2.2	81	30	48	2	7	28	32	26	75	2.37	-.8	7	13.2	s.	38	s.	15	7	11	13	6.2	4.0	.0	3
St. Louis [2]	568	179	303	29.53	40.6	-3.5	81	30	50	5	3	31	33	27	64	3.19	-.2	8	13.9	nw.	41	sw.	15	9	11	11	5.6	4.5	.0	4
Missouri Valley					33.8	-3.6									66	1.11	-0.8										5.6			
Columbia, Mo. [1]	784	6	66	29.27	39.0	-3.6	83	30	50	0	7	28	37	25	63	1.76	-1.2	11	9.4	s.	24	nw.	6	10	16	5	5.0	4.0	.0	4
Kansas City [1]	963	38	76	29.07	39.0		81	30	50	2	7	28	50	26	63	1.17	-1.4	11	13.2	sw.	41	nw.	15	8	11	12	5.8	6.0	.0	3
St. Joseph [2]	967	11	49	29.06	37.2	-3.3	84	30	48	0	7	26	53	25	67	.62	-1.9	6	11.1	s.	35	w.	16	15	8	8	4.2	5.7	.0	1
Springfield, Mo. [1]	1,324	5	60	28.68	38.6	-5.0	78	30	50	-8	7	28	38	28	69	3.16	-.2	12	13.1	se.	34	s.	15	7	8	16	6.4	10.8	.0	5
Topeka	987	65	87	29.04	38.8	-3.8	85	30	50	1	7	28	55	26	64	.68	-1.4	8	11.2	s.	34	s.	30	11	10	10	5.4	7.4	.0	0
Lincoln [2]	1,189	11	81	28.80	34.7	-2.8	85	30	46	-5	7	23	44	22	67	.87	-.4	5	12.0	s.	47	w.	16	10	9	12	5.7	10.5	.0	1
Omaha [1]	1,105	31	44	28.90	33.5	-2.6	85	30	46	-6	7	22	48	21	65	.98	-.4	4	14.4	s.	36	w.	16	9	11	11	5.9	10.5	.0	1
Valentine	2,598	46	54	27.27	27.0	-5.3	87	29	41	-21	7	13	44	10	52	.74	-.3	5	8.9	w.	29	nw.	16	8	10	13	5.9	12.4	.0	0
Sioux City [1]	1,138	5	27	28.84	30.0	-2.1	89	30	42	-9	7	18	48	20	72	.34	-.8	6	13.2	nw.	41	nw.	16	10	8	13	5.8	4.5	.0	1
Huron [1]	1,301	5	41	28.64	25.4	-3.5	89	30	37	-14	7	14	49	17	77	.74	-.2	7	13.5	nw.	41	w.	17	9	9	13	6.1	5.0	.0	1
Northern Slope					25.6	-6.6									66	0.72	-0.3										6.5			
Billings [1]	3,570	18	39	26.28	25.4	-8.6	75	29	37	-13	16	14	34	15	66	1.80		8	11.7	sw.	38	nw.	30	5	14	12	6.6	17.7	.0	0
Havre	2,507	11	67	27.36	22.9	-4.2	72	28	35	-19	16	11	37	13	66	.39	-.1	5	10.2	sw.	37	sw.	30	6	5	20	7.2	7.8	.0	0
Helena [1]	4,124	5	35	25.76	21.0	-10.7	68	28	33	-14	6	9	35	14	73	.39	-.4	9	8.3	nw.	56	s.	29	7	9	15	6.4	9.2	.0	0
Missoula [2]	3,205	80	91	26.61	30.0	-5.6	69	28	40	-3	6	20	35	21	76	.73	-.2	10	7.2	sw.	43	ne.	1	8	7	16	6.7	5.3	.0	0
Kalispell	2,973	48	56	26.91	25.3	-7.6	59	28	36	-10	6	15	34	17	69	.90	-.5	12	5.8	w.	25	sw.	30	7	6	18	7.1	6.2	.0	0
Miles City [2]	2,371	48	55	27.51	25.0	-3.6	83	29	38	-11	6	12	48	14	64	.27		5		s.				5	2	24		7.9	.0	0
Rapid City [2]	3,259	50	58	26.60	25.4	-7.2	82	29	38	-15	5	12	41	15	67	.84	-.1	7	14.1	nw.	51	nw.	16	7	10	14	6.3	11.9	.0	0
Cheyenne [1]	6,094	5	39	23.89	28.4		73	29	42	-21	2	15	42	16	61	.95	-.1	7	12.3	nw.	38	nw.	16	6	10	15	6.6	10.7	.0	0
Lander	5,352	60	68	24.57	25.7	-6.7	72	29	40	-21	6	11	48	12	55	.94	-.2	5	5.1	sw.	35	sw.	14	10	10	11	5.4	10.1	.0	0
Sheridan [2]	3,790	6	42	26.07	23.0	-8.4	76	29	37	-17	2	9	42	13	68	.81	-.4	7	8.1	nw.	38	nw.	14	8	8	15	6.3	10.4	.0	0
North Platte [2]	2,821	11	51	27.05	32.8	-3.8	87	30	48	-16	6	18	45	18	65	.50	-.4	3	8.6	w.	31	nw.	16	9	7	15	6.0	7.0	.0	0

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure, station reduced to mean of 24 hours	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature: Departure from normal	Temperature: Maximum	Temperature: Date	Temperature: Mean maximum	Temperature: Minimum	Temperature: Date	Temperature: Mean minimum	Temperature: Greatest daily range	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch or more	Wind: Average hourly velocity	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month	Number of days with thunderstorms
	Ft.	Ft.	Ft.	In.	° F.	° F.	° F.		° F.	° F.		° F.	° F.	° F.	%	In.	In.		Miles								0-10	In.	In.	
Middle Slope					39.6	−4.5									61	0.97	−0.5										5.7			
Denver [2]	5,292	106	113	24.65	36.4	−2.9	79	29	49	−7	6	24	42	15	51	.77	−.3	6	8.0	s.	29	n.	9	8	11	12	6.0	11.9	0.0	0
Pueblo [1]	4,690	5	36	25.21	37.0	−3.8	86	29	54	−10	3	20	47	18	54	.23	−.4	7	9.0	w.	49	nw.	15	6	12	13	6.2	5.3	.0	0
Concordia	1,392	50	58	28.60	37.2	−3.8	85	29	49	−2	7	25	42	24	63	.72	−.5	6	10.7	s.	32	nw.	15	9	11	11	5.8	9.1	.0	0
Dodge City [1]	2,509	10	86	27.40	38.6	−4.2	88	30	53	−5	6	24	44	23	60	.34	−.6	5	18.2	s.	51	nw.	31	10	12	9	5.5	7.4	.0	0
Wichita [1]	1,358	6	64	28.63	39.0	−6.1	81	29	51	−3	7	27	52	27	69	1.21	−.5	9	17.3	s.	47	s.	30	12	5	14	5.7	10.1	.0	1
Oklahoma City [2]	1,214	10	47	28.77	45.2	−4.8	84	15	57	8	3	34	50	31	65	1.45	−.5	11	11.8	s.	26	s.	9	11	11	9	4.9	3.9	.0	0
Tulsa	674	10	61	29.36	43.8	−5.6	81	15	55	3	3	32	43	31	65	2.09	−.9	11	13.3	s.	38	sw.	9	10	9	12	5.6	2.8	.0	2
Southern Slope					52.4	−2.2									49	0.94	+0.1										5.5			
Abilene [2]	1,738	10	56	28.20	52.6	−3.9	88	18	65	11	3	40	40	33	57	3.18	+1.9	4	12.2	s.	30	s.	9	8	12	11	5.9	T	.0	2
Amarillo [2]	3,676	10	49	26.23	43.8	−3.1	86	30	60	4	6	28	46	23	50	.01	−.7	1	16.6	se.	54	w.	15	10	8	13	5.5	.2	.0	1
Del Rio	960	63	71	28.97	62.0	−1.5	92	15	74	27	3	50	38	39	48	.57	−.2	2	11.2	se.	32	n.	6	12	12	7	4.6	.0	.0	1
Roswell	3,566	75	85	26.32	51.0	−.3	88	29	67	14	3	35	45	26	42	T	−.7	0	8.9	s.	42	w.	4	9	6	16	5.9	T	.0	0
Southern Plateau					57.6	+2.7									41	0.58	0.0										4.5			
El Paso [1]	3,778	82	101	26.12	55.8	+.9	88	29	70	22	3	41	41	25	33	.07	−.3	2	12.6	sw.	48	w.	5	14	5	12	4.8	.0	.0	2
Albuquerque [1]	5,314	5	45	24.67	48.2	+2.3	81	29	62	15	3	35	35	25	45	.23	−.2	4	10.2	n.	68	nw.	18	8	11	12	5.7	T	.0	2
Phoenix [2]	1,107	39	87	28.77	63.9	+3.2	92	28	78	40	20	50	39	35	43	.73	.0	3	5.8	e.	31	sw.	18	11	12	8	4.5	.0	.0	2
Tucson [1]	2,555	5	23	27.32	61.8	----	91	29	76	40	21	47	39	30	38	1.27	+.5	3	----	se.	----	----	----	12	9	10	4.9	.0	.0	1
Yuma	142	9	54	29.78	68.0	+3.9	95	28	82	47	1	54	41	39	41	.27	−.1	1	6.5	w.	25	w.	18	24	4	3	2.4	.0	.0	0
Independence	3,957	5	26	25.97	51.9	+3.4	78	26	65	31	19	39	37	29	46	.89	+.4	6	----	n.	----	----	----	14	10	7	----	.0	.0	0
Middle Plateau					41.9	+1.3									58	1.25	+0.3										6.1			
Reno [2]	4,527	61	76	25.44	43.9	+2.8	74	27	58	10	18	30	46	29	61	1.81	+1.0	6	7.5	nw.	47	s.	29	9	8	14	5.7	3.1	.0	0
Tonopah	6,090	9	20	23.99	41.9	+1.4	67	27	52	20	16	32	28	27	62	.72	+.2	10	----	nw.	----	----	----	15	10	6	----	3.0	.0	0
Winnemucca	4,339	5	56	25.60	42.2	+2.2	73	28	54	14	18	30	37	28	63	.79	−.2	8	8.3	sw.	45	w.	29	11	4	16	5.8	1.8	.0	0
Modena	5,473	10	46	----	40.4	+2.2	72	28	54	15	19	27	44	----	----	1.41	+.4	11	9.4	sw.	32	s.	29	10	7	14	5.9	2.6	.0	5
Salt Lake City [1]	4,227	32	46	25.58	40.2	+.2	77	28	51	18	3	30	37	26	59	1.23	−.6	10	9.2	se.	38	s.	29	5	8	18	7.3	7.2	.0	2
Grand Junction	4,602	60	68	25.33	42.8	−.8	77	29	55	18	16	31	34	22	47	1.53	+.8	6	6.2	s.	32	nw.	30	6	15	10	5.9	6.6	.0	2
Northern Plateau					38.8	−2.0									65	1.28	0.0										6.4			
Baker [2]	3,471	36	54	26.42	36.4	−1.2	66	27	46	14	18	26	31	26	72	.36	−.7	9	6.6	s.	27	sw.	29	6	13	12	5.9	2.4	.0	0
Boise [1]	2,739	5	49	27.16	39.9	−1.5	76	28	50	18	2	30	33	27	62	2.08	+.7	9	10.6	se.	49	w.	29	6	10	15	6.3	1.0	.0	1
Pocatello [1]	4,478	5	31	25.42	35.1	−.8	72	28	45	7	2	25	32	24	64	1.52	+.2	15	10.4	sw.	30	sw.	5	5	12	14	6.8	6.1	.0	0
Spokane [1]	1,929	27	42	27.96	35.8	−3.9	60	25	45	9	5	27	30	26	68	1.60	−.4	9	7.7	sw.	25	sw.	24	9	5	17	6.6	1.5	.0	1
Walla Walla	991	57	65	28.97	43.8	−2.3	70	27	52	19	5	36	26	----	----	1.40	−.2	8	6.7	s.	24	sw.	11	7	6	18	6.5	T	.0	0
Yakima	1,076	58	67	28.86	42.0	−2.1	64	25	53	20	6	31	33	27	57	.72	+.3	6	5.8	nw.	26	s.	27	7	8	16	6.5	T	.0	0
North Pacific Coast Region					46.3	+0.6									71	4.95	+0.9										6.8			
North Head	211	5	56	29.78	45.0	−.2	64	1	50	33	17	40	26	38	79	5.48	−.1	19	14.3	s.	54	s.	27	6	6	19	7.0	T	.0	0
Seattle [2]	125	90	321	29.87	45.5	−.9	60	2	52	32	10	38	23	34	69	4.39	+1.3	10	10.6	s.	38	sw.	11	7	6	18	7.0	.0	.0	0
Tacoma	194	172	201	29.80	44.3	+.1	57	3	51	29	18	37	23	----	----	6.11	+2.6	16	9.2	sw.	34	s.	30	10	7	14	6.1	T	.0	0
Tatoosh Island	86	9	61	29.89	44.2	+1.3	57	1	48	36	14	40	18	35	71	6.58	−1.3	17	16.0	e.	50	s.	24	8	8	15	6.5	T	.0	0
Medford [1]	1,329	29	58	28.62	48.7	+1.8	71	27	61	25	20	36	40	35	65	1.51	.0	8	----	nw.	----	----	----	7	6	18	6.4	T	.0	0
Portland, Oreg. [5]	154	68	106	29.87	47.2	+.3	63	25	54	31	18	41	26	36	72	7.26	+3.4	12	7.1	s.	23	ne.	2	8	3	20	7.1	T	.0	0
Roseburg	510	45	76	29.50	49.0	+1.9	71	25	60	27	18	38	39	39	72	3.35	+.1	14	3.7	di.	22	sw.	27	5	6	20	7.2	T	.0	0
Middle Pacific Coast Region					54.0	+1.3									77	4.56	+0.6										6.3			
Eureka	60	72	88	30.03	50.9	+2.6	64	24	56	35	16	45	18	45	82	5.83	+.6	12	6.5	se.	23	w.	29	5	8	18	7.1	.0	.0	0
Redding [1]	722	20	34	29.26	54.2	+.2	75	23	63	36	30	45	29	41	64	5.65	+1.0	15	7.3	nw.	27	w.	14	8	3	20	6.7	.0	.0	2
Sacramento [2]	66	92	115	29.98	55.2	+.9	74	25	64	39	1	47	28	48	80	3.60	+1.0	12	6.7	s.	21	sw.	14	14	3	14	5.3	.0	.0	1
San Francisco	155	112	132	29.89	55.6	+1.4	70	25	60	45	15	51	20	48	81	3.18	.0	12	7.5	w.	26	w.	14	7	11	13	6.0	.0	.0	0
South Pacific Coast Region					58.4	+2.1									75	3.14	+1.1										6.0			
Fresno [1]	327	5	35	29.67	56.4	+2.0	77	28	66	37	15	46	30	47	75	3.21	+1.6	12	5.0	nw.	26	nw.	17	9	8	14	6.3	.0	.0	3
Los Angeles	338	223	250	29.68	58.8	+1.3	80	31	66	45	2	51	29	49	76	4.55	+1.8	10	6.3	w.	25	e.	3	8	9	14	5.9	.0	.0	1
San Diego [1]	87	20	55	29.96	60.0	+3.0	75	31	67	46	19	53	25	51	75	1.66	−.1	8	6.8	w.	26	se.	3	8	11	12	5.9	.0	.0	0
West Indies																														
San Juan, P. R.	82	10	54	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Panama Canal																														
Balboa Heights	118	6	92	[3]29.78	81.0	−.2	93	15	90	68	5	72	22	----	[3]78	1.50	+.8	12	7.0	nw.	22	nw.	3	6	23	2	4.9	.0	.0	3
Cristobal	27	47	97	[3]29.86	81.4	−.1	89	22	85	74	7	78	11	72	[3]73	1.15	−.4	9	13.3	n.	26	n.	25	5	22	4	4.9	.0	.0	1
Alaska																														
Nome	43	25	51	----	11.2	+2.5	34	15	20	−25	21	3	----	----	84	2.19	+1.3	12	11.8	n.	40	ne.	26	13	2	16	----	19.3	33.1	0
Fairbanks	455	4	82	----	10.0	+.4	40	15	20	−28	29	0	----	4	70	1.21	+.5	10	6.9	e.	32	w.	6	7	7	17	----	18.4	19.2	0
Juneau	80	96	116	----	33.4	−.4	52	1	39	14	13	28	----	24	46	2.89	−2.6	15	6.4	se.	24	se.	26	6	7	18	----	22.1	1.0	0
Anchorage	135	36	47	----	23.6	−.1	45	6	33	−8	23	14	----	15	63	.39	−.2	5	5.4	n.	25	s.	19	10	6	15	----	2.4	T	0
Hawaiian Islands																														
Honolulu	38	86	100	29.94	71.6	+.2	81	24	77	61	14	66	15	----	----	2.83	−.4	11	8.9	ne.	32	ne.	9	8	12	11	6.0	.0	.0	1

LATE REPORTS FOR FEBRUARY 1943

Alaska																														
Bethel	22	5	32	[4]29.60	12.4	+2.9	42	27	20	−28	6	5	32	8	74	2.05	+1.3	15	----	ne.	----	----	----	9	2	17	6.2	12.7	9.6	----
Fairbanks	484	11	87	[4]29.35	4.8	+6.0	50	24	16	−51	6	−6	39	2	78	.35	−.1	4	3.9	n.	18	ne.	10	7	4	17	6.4	2.5	12.0	----
Ketchikan	75	69	85	[4]29.91	39.0	+4.0	59	16	44	20	8-9	34	24	35	84	20.70	+9.4	18	7.4	se.	31	se.	10	4	6	18	7.8	16.6	.0	----
Kotzebue	20	4	31	[4]29.83	−.4	+4.2	35	28	9	−30	6	−10	37	−2	94	.52	+.3	10	----	se.	35	se.	28	9	3	16	6.0	6.0	8.5	----
McGrath	331	4	31	[4]29.42	8.0	----	55	24	19	−47	8	−3	49	4	79	2.23	----	11	----	n.	33	s.	22	9	2	17	6.1	17.7	14.5	----
Nome	43	25	51	[4]29.72	9.0	+3.4	34	27	18	−23	4	0	34	8	88	2.28	+1.5	17	12.7	ne.	37	s.	23	7	4	17	7.0	19.8	27.8	----

[1] Data are airport records.
[2] Barometric data (adjusted to old city elevations) and hygrometric data from airport; otherwise city office records.
[3] Observations taken bihourly.
[4] Pressure not reduced to a mean of 24 hours.
[5] Wind, clear, partly cloudy, and cloudy data from city office records; other data from airport.

NOTE.—Except as indicated by notes 1, 2, and 5 data in table are city office records.

SEVERE LOCAL STORMS, MARCH 1943

[Compiled by Mary O. Souder]

[The table herewith contains such data as has been received concerning severe local storms that occurred during the month. A revised list of tornadoes will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
DeLand, Fla.	3	4 p. m.				Squall	Trees blown down; small buildings unroofed and otherwise damaged; considerable damage reported.
San Augustine, Tex.	5	4:45 p. m.	400	1	$500,000	Tornado	8 persons injured; no crop loss.
Jacksonville, Fla., and vicinity.	6	8:45 a. m.			500,000	Straight-line-wind	Damage widespread over the city and county, the greatest damage invariably being observed in areas where open space without obstructions to windward permitted an increased sweep of the wind to higher velocities. 30 persons required treatment for injuries. No tornadic formation observed, but such was possible over small localities.
Charleston, S. C., 7 miles north.	12	8:15-8:25 p. m.			5,000	Thundersqualls	Damage mostly to garages, particularly those without doors, and it appeared that the wind had lifted them from their foundations and let them down a few feet away where they had collapsed; area widespread.
Minnesota, southern and eastern counties.	14-16			2	300,000	Glaze, sleet, snow, and wind.	Telephone, telegraph, and electric service disrupted; all traffic delayed. In some places trees and shrubs damaged considerably. In Duluth, Minn., from 6 to 13 inches of snow fell. Maximum wind velocity for a 5-minute period recorded as 47 miles from the northeast at 5:56 p. m., on the 15th. The Park Point district completely isolated from the remainder of the city and drifts reported from 15 to as much as 25 feet high. Bus schedules disrupted being seriously handicapped by low visibility and many manufacturing plants were idle as employees could not get to work. On the 14th and 15th schools were closed, public meetings postponed, and persons advised to stay at home. By afternoon of the 16th most highways and city streets were cleared and business resumed.
Madison, Dallas, and Polk Counties, Iowa.	15	4 p. m.	167-334	0	10,000	Tornado	Storm traveled through a rural area and lifted frequently over a path above 30 miles long; 1 person injured.
Decatur and Lucas Counties, Iowa.	15	5:30 p. m.		0		do	Storm developed in Decatur County and traveled northeastward for about 12 miles into Lucas County; occurring in a rural area, lifting and dipping at times with great destruction where it traveled along the ground.
Marshalltown, Iowa, and vicinity.	15	6 p. m.		0		Tornado and hail	The tornado dipped to the ground and wrecked buildings on a farm 5 miles south of Green Mountain. The monetary value of the property destroyed is not known. It would have been possible for this storm to have been a redevelopment of the Dallas-Polk County twister, but definite evidence to connect the two phenomena is lacking.
Hancock, Iowa, vicinity of	15	3 p. m.		0		Tornado	Following a thunderstorm and a heavy fall of hail, a black cloud developed into a tornado funnel. The cloud rose and fell, but remained aloft most of the time. Damage mostly confined to telephone wires. No further details are available, except that it became much colder shortly after the tornado passed.
Independence, Iowa	15	7:15 p. m.		0	250,000	do	Buildings wrecked in an area 176 yards long and 59 yards wide. The area of destruction was crescent shaped, curving from southeast to northwest and then northeast. 6 persons were injured.
Andrew, Iowa, vicinity of	15	9 p. m.		0		do	No details of this storm are available, but because synoptic weather conditions favored development of tornadoes, and, because of the prevalence of such storms on this date, it is being classified as one.
Douglas, Bayfield, and Ashland Counties, Wis.	15-16					Strong winds and snow.	Traffic almost at standstill and most schools closed; many drifts 7 feet deep. In Superior streets were impassible and the city bus service was badly disrupted or stopped.
Wisconsin, west-central portion.	15-16					Glaze and wind	The deposit of glaze varied in thickness from light to heavy and damage to poles and wires was quite extensive.
South Dakota, entire State	15-17					High winds and snow.	Rain turned to snow accompanied by fresh to strong winds and temperatures lowering to below zero by the 16th. Business was disrupted with traffic cancelled or delayed and communication lines damaged. There were stock losses in the western border counties; some schools closed and several persons injured on icy walks.
Winona, Minn	16	8:30 p. m. to midnight.				Glaze	Heavy rain froze as it fell, caused severe property damage. Poles and wires broken by weight of ice caused disruption of telephone and electric service. Highways slippery and little motor travel.
Tylertown, Miss., vicinity of	18			0	2,000	Tornado	Property damaged.
Harrison County, Ind	19	2:15 p. m.	433	0	10,000	do	Damage mostly to school buildings in Laconia; 2 boys slightly injured.
Devine, Tex	24	6:20-6:50 p. m.			43,700	Hail, straight-line wind.	Damage to buildings, $2,500; loss in crops and stock, $41,200.

SOLAR RADIATION AND SUNSPOT DATA FOR MARCH 1943

[Solar Radiation Investigations Section, I. F. HAND in charge]

SOLAR RADIATION OBSERVATIONS

Explanations of the tables and references to descriptions of instruments, stations and methods of observation, and to summaries of data, are given in the January 1942 REVIEW, page 20; a list of pyrheliometric stations is also given in the REVIEW for January 1943, page 12.

TABLE 1.—*Solar radiation intensities during March 1943*

[Gram-calories per minute per square centimeter of normal surface]

MADISON, WIS.

Date	Sun's zenith distance										
	7:30 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	1:30 p. m.
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e.	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
Mar. 8	0.48			0.98	1.35						0.76
12	1.85		0.66	1.03	1.26	1.45					3.63
13	3.81		.64	.76	1.07	1.24	0.88				5.18
18	1.37		.79	1.02							1.75
20	1.52	0.61	.87	1.08	1.26	1.56	1.25				2.62
22	1.96	.83	.95	1.07	1.18	1.25	1.22				3.30
23	2.87	.59	.73	.87	1.06	1.35					3.81
24	4.98	.35	.47	.66	.84				Very smoky		6.81
26	5.82				1.25	1.52					3.63
29	2.87	.33	.50	.66	.90						5.18
Means		.54	.70	.90	1.13	1.40	1.12				
Departures		−.31	−.28	−.22	−.17	−.14	−.17				

LINCOLN, NEBR.

Date	Sun's zenith distance										
	7:30 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	1:30 p. m.
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e.	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
Mar. 2	0.76	0.92	1.09	1.22	1.40						0.56
6	.97	.94	1.02	1.18	1.37						1.17
10	.51	.60	.75	.92	1.13						.66
12	4.19						1.05	0.83			2.24
19	2.16		.77	.96	1.18		1.33	1.16	1.02	0.94	2.16
21	1.96						1.24	1.09	.94		3.30
22	2.74	.77	.92	1.07	1.24						3.81
24	4.98	.45	.58	.75							7.06
26	4.78	.81	.94	1.07	1.29						3.30
28	3.63						.94	.68	.54	.43	5.82
30	8.86	.58	.70	.85	1.03						8.23
31	5.38						1.17	1.01	.84	.71	5.38
Means		.72	.85	1.00	1.23		1.15	.95	.84	.69	
Departures		−.12	−.09	−.09	−.05		−.12	−.13	−.10	−.13	

BLUE HILL, MASS.

Date	7:30 a. m.	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	1:30 p. m.
Mar. 4	1.0				1.31		1.27	1.11			1.4
8	1.7	0.91	1.07	1.16	1.34						1.7
14	4.4	.77	0.89								3.8
21	3.2		.97	1.10							2.4
23	2.6								1.06	0.95	1.7
24	2.7	.96	.98	1.11							4.0
Means		.88	.98	1.12	(1.32)		(1.27)	(1.11)	(1.06)	(.95)	
Departures		−.02	.00	+.01	+.08		+.03	+.03	+.10	+.09	

*Extrapolated.

TABLE 2.—*Daily totals and weekly means of solar radiation (direct+diffuse) received on a horizontal surface*

[Gram-calories per square centimeter]

Date	Washington	Madison	Lincoln	East Lansing	New York	Columbus	Fairbanks	Nashville	Twin Falls	Riverside	New Orleans	Blue Hill	Ithaca	Newport	State College	Put-in-Bay	East Wareham	Davis, Calif.
1943	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.		
Feb. 26	90	388	410	253	164	177	12	173	385	435	481	215	132	294	136	194	327	189
27	432	354	391	184	279	308	2	420	409	412	526	325	251	331	319	215	316	444
28	373	396	362	225	345	426	28	268	355	388	96	332	173	389	112	241	390	430
Mar. 1	415	415	196	341	244		58	383	410	417		410	343	418	356	211	400	457
2	303	426	356	231	313		86	16	440	321		273	229	325	161	176	301	386
3	204	388	357	383	85		110	412	406	78		91	290	82	347	441	85	97
4	458	293	388	328	374		92	420	358	173		478	396	469	414	356	477	180
Mean	325	380	351	278	258		56	299	395	318		304	259	330	264	262	328	312
Departure	+43	+8	+39		−9		−76	+37	+109	−41		+5	+25	+33	+32			
5	402	293	194	312	284	281	66	19	447	272		391	320	365	202	351	384	206
6	60	224	488	87	25	29	117	13	384	437		60	128	55	71	32	57	185
7	474	451	461	416	444	288	142	453	215	388		401	341	438	380	304	68	330
8	474	350	332	504	408	390	106	474	122	264		400	369	444	459	467	336	91
9	459	85	249	145	415	318	95	429	441	162		415	269	462	305	141	461	208
10	355	287	432	39	236	126	74	239	425	344		244	321	236	409	44	189	423
11	177	435	249	365	133	14	132	20	439	453		156	52	205	48	128	148	499
Mean	343	304	344	267	278	206	104	235	353	332		295	257	315	268	210	235	277
Departure	+30	+6	+19		+2		−45	−28	+4	−69		+2	+4	+18	+4			
12	360	472	348	372	378	330	237	19	363	501		192	398	197	342	421	170	419
13	111	412	372	314	48	440	212	260	197	349		79	283	64	145	419	94	223
14	465	202	330	288	383	331	105	432	178	185		442	418	438	370	339	429	537
15	407	37	64	179	395	226	99	174	406	326		365	335	429	351	279	388	559
16	172	265	402	91	30	57	79	81	248	460		52	93	50	227	43	57	358
17	93	318	466	435	36	506	136	433	232	154	188	70	257	60	220	459	62	112
18	478	320	122	335	394	259	168	265	489	326	352	440	437	457	405	403	464	567
Mean	298	289	301	288	238	307	148	238	309	329		234	317	242	294	337	238	397
Departure	−19	−29	−50		−43		−47	−64	−21	−65		−63	+89	−60	+9			
19	176	58	543	92	53	24	177	181	365	278	326	97	35	76	36	26	103	556
20	366	523	435	297	236	546	219	429	528	529	131	96	462	271	409	456	224	519
21	110	455	502	372	220	177	268	256	456	272	411	398	288	376	152	352	404	144
22	320	493	502	432	266	305	279	516	476	204		277	329	205	297	475	210	505
23	558	467	175	507	551	555	279	519	484	538	662	491	544	528	544	530	467	540
24	488	414	476	381	331	384	16	409	437	533	577	366	282	482	331	400	493	430
25	341	422	411	339	466	282	275	447	462	526	356	449	451	492	400	414	484	523
Mean	337	404	435	346	303	325	216	394	458	411	410	311	342	347	310	379	341	459
Departure	−7	+72	+55		−42			+34	+55	+20	+46	−73	+31	−75	−15			
26	352	508	532	220	382	124	253	17	235	438	127	486	324	463	316	301	465	453
27	116	373	263	449	104	410	306	84	449	496	469	288	514	160	140	465	175	526
28	474	272	482	496	482	405	325	367	443	452	471	569	479	530	500	494	489	571
29	588	447	460	419	536	479	326	527	317	245	631	550	597	578	570	466	523	299
30	527	454	480	422	48	491	340	522	552	457	625	119	29	100	258	384	112	605
31	517	183	554	456	97	512	346	435	431	553	384	91	418	88	481	501	92	592
Apr. 1	278	205	482	411	200	490	343	377	518	547	409	246	178	229	124	551	201	594
Mean	407	349	465	410	264	416	306	333	421	455	445	336	363	307	342	452	294	520
Departure	+57	−3	+91		−63		+19	−45	+53	+57	+81	−45	+69	−58	−18			
ACCUMULATED DEPARTURES ON APR. 1, 1943																		
	+490	+1596	+903		−1036		−2681	+21	+1092	−609		−1743	+1974	−1365	+1099			

POSITIONS, AREAS, AND COUNTS OF SUNSPOTS FOR MARCH 1943

[Communicated by Capt. J. F. Hellweg, U. S. N. (Ret.), Superintendent, U. S. Naval Observatory.] All measurements and spot counts were made at the Naval Observatory from plates taken at the observatories indicated. Difference in longitude is measured from the central meridian, positive toward the west. Latitude is positive toward the north. Areas are corrected for foreshortening and expressed in millionths of Sun's hemisphere. For each day, under longitude, latitude, area of spot or group, and spot count, are included assumed longitude of center of the disk, assumed latitude of center of the disk, total area of spots and groups, and total spot count.

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1943	*h m*		°	°	°	°				
Mar. 1	10 49	(*)	+37	85	+21	46	12	2	G	U.S. Naval.
		7555	+48	96	+11	51	388	20		
		7555	+53	101	+10	56	970	12		
		7557	+70	118	+ 6	71	18	1		
				(48)	(−7)	......	1388	35		
2	10 52	7555	+62	97	+11	64	388	18	F	Do.
		7555	+67	102	+10	68	873	10		
				(35)	(−7)	......	1261	28		
3	13 16	7555	+80	100	+11	80	727	7	P	Do.
				(20)	(−7)	......	727	7		
4	12 46	7559	−88	279	+ 5	88	194	3	G	Do.
		7559	−78	289	+ 5	78	485	6		
				(7)	(−7)	......	679	9		
5	11 46	7559	−75	280	+ 8	76	194	2	F	Do.
		7559	−70	285	+ 5	70	436	10		
		7559	−65	290	+ 5	66	194	4		
				(355)	(−7)	......	824	16		
6	10 44	7559	−62	280	+ 8	64	121		G	Mt. Wilson
		7559	−57	285	+ 6	58	436	25		
		7559	−51	291	+ 5	53	145	6		
				(342)	(−7)	......	702	40		
7	11 37	7559	−48	281	+ 8	50	97	12	G	Do.
		7559	−43	286	+ 6	46	630	35		
		7559	−38	291	+ 5	41	121	5		
		7560	+26	355	+ 4	29	12	2		
				(329)	(−7)	......	860	54		
8	14 4	7559	−34	280	+ 8	38	145	9	VG	U.S. Naval.
		7559	−28	286	+ 5	31	339	14		
		7559	−24	290	+ 4	27	582	11		
				(314)	(−7)	......	1066	34		
9	10 59	7559	−20	283	+8	25	121	11	VG	Do.
		7559	−16	287	+5	20	436	16		
		7559	−11	292	+4	16	630	14		
				(303)	(−7)	......	1,187	41		
10	11 46	7559	−6	283	+7	16	97	7	G	Do.
		7559	−3	286	+5	12	485	18		
		7559	+4	293	+4	12	630	15		
				(289)	(−7)	......	1,212	40		
11	10 43	7561	−68	208	−10	68	24	1	VG	Mt. Wilson.
		7559	+8	284	+6	16	48	4		
		7559	+12	288	+5	18	485	12		
		7559	+18	294	+4	22	630	20		
				(276)	(−7)	......	1,187	37		
12	12 48	7561	−55	207	+11	57	12	1	F	U. S. Naval.
		7559	+26	288	+5	30	291	15		
		7559	+32	294	+4	34	533	10		
				(262)	(−7)	......	836	26		
13	11 21	7561	−42	208	−11	42	48	10	VG	Mt. Wilson.
		7559	+39	289	+5	41	242	13		
		7559	+45	295	+4	47	533	12		
				(250)	(−7)	......	823	35		
14	11 32	7562	−70	166	+10	71	12	1	F	U. S. Naval.
		7559	+51	287	+7	53	145	6		
		7559	+59	295	+4	60	533	3		
				(236)	(−7)	......	690	10		

POSITIONS, AREAS, AND COUNTS OF SUNSPOTS FOR MARCH 1943—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1943	*h m*		°	°	°	°				
Mar. 15	10 48	7562	−57	167	+9	60	12	1	F	U. S. Naval.
		7559	+72	296	+4	72	533	3		
				(224)	(−7)	......	545	4		
16	10 56	7559	+84	294	+4	84	388	2	G	Mt. Wilson.
				(210)	(−7)	......	388	2		
18	11 11	7563	−75	109	+10	76	218	1	F	U. S. Naval.
		(*)	+20	204	−9	20	24	1		
				(184)	(−7)	......	242	2		
19	13 11	7563	−60	110	+10	62	291	3	G	Do.
		7564	−4	166	−13	7	48	5		
				(170)	(−7)	......	339	8		
20	10 56	7563	−47	111	+10	50	242	4	F	Do.
		7564	+9	167	−12	10	73	6		
		7565	+17	175	−8	17	18	2		
				(158)	(−7)	......	333	12		
22	10 34	7566	−37	94	+9	42	291	12	G	Do.
		7563	−21	110	+11	28	194	4		
		7563	−14	117	+11	22	36	5		
		(*)	+32	163	−11	32	12	1		
				(131)	(−7)	......	533	22		
23	11 27	7567	−23	95	+11	29	48	5	F	Do.
		7566	−23	95	+9	28	339	2		
		7563	−7	111	+11	20	194	6		
				(118)	(−7)	......	581	13		
24	10 44	7567	−10	95	+11	21	121	8	G	Do.
		7566	−10	95	+10	20	315	5		
		7563	+7	112	+10	18	194	12		
				(105)	(−7)	......	630	25		
25	12 36	7567	+3	94	+11	18	121	8	VG	Do.
		7566	+4	95	+10	17	267	12		
		7563	+21	112	+10	27	194	18		
				(91)	(−7)	......	582	38		
26	11 10	7567	+17	95	+11	25	97	7	VG	Do.
		7566	+18	96	+9	25	242	9		
		7563	+33	111	+10	38	145	10		
				(78)	(−7)	......	484	26		
27	10 35	7567	+31	96	+11	36	48	5	VG	Mt. Wilson.
		7566	+32	97	+9	35	194	1		
		7563	+47	112	+9	50	97	7		
				(65)	(−7)	......	339	13		
28	10 44	7567	+43	95	+11	47	12	2	VG	Do.
		7566	+46	98	+9	49	194	1		
		7563	+61	113	+9	63	24	5		
				(52)	(−7)	......	230	8		
29	10 49	7568	−38	1	−9	38	145	17	G	U. S. Naval.
		7566	+59	98	+9	61	194	1		
		7563	+78	117	+9	79	24	3		
				(39)	(−7)	......	363	21		
30	11 12	7568	−25	1	−9	25	194	20	G	Do.
		7566	+72	98	+9	73	194	1		
				(26)	(−7)	......	388	21		
31	10 20	7569	−78	295	+3	78	485	2	VG	Do.
		7568	−11	2	−10	11	194	25		
		7566	+87	100	+9	87	97	1		
				(13)	(−7)	......	776	28		

Mean daily area for 29 days=696.

(*) Not numbered.
VG=very good; G=good; F=fair; P=poor.

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, March 1943

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, March 1943

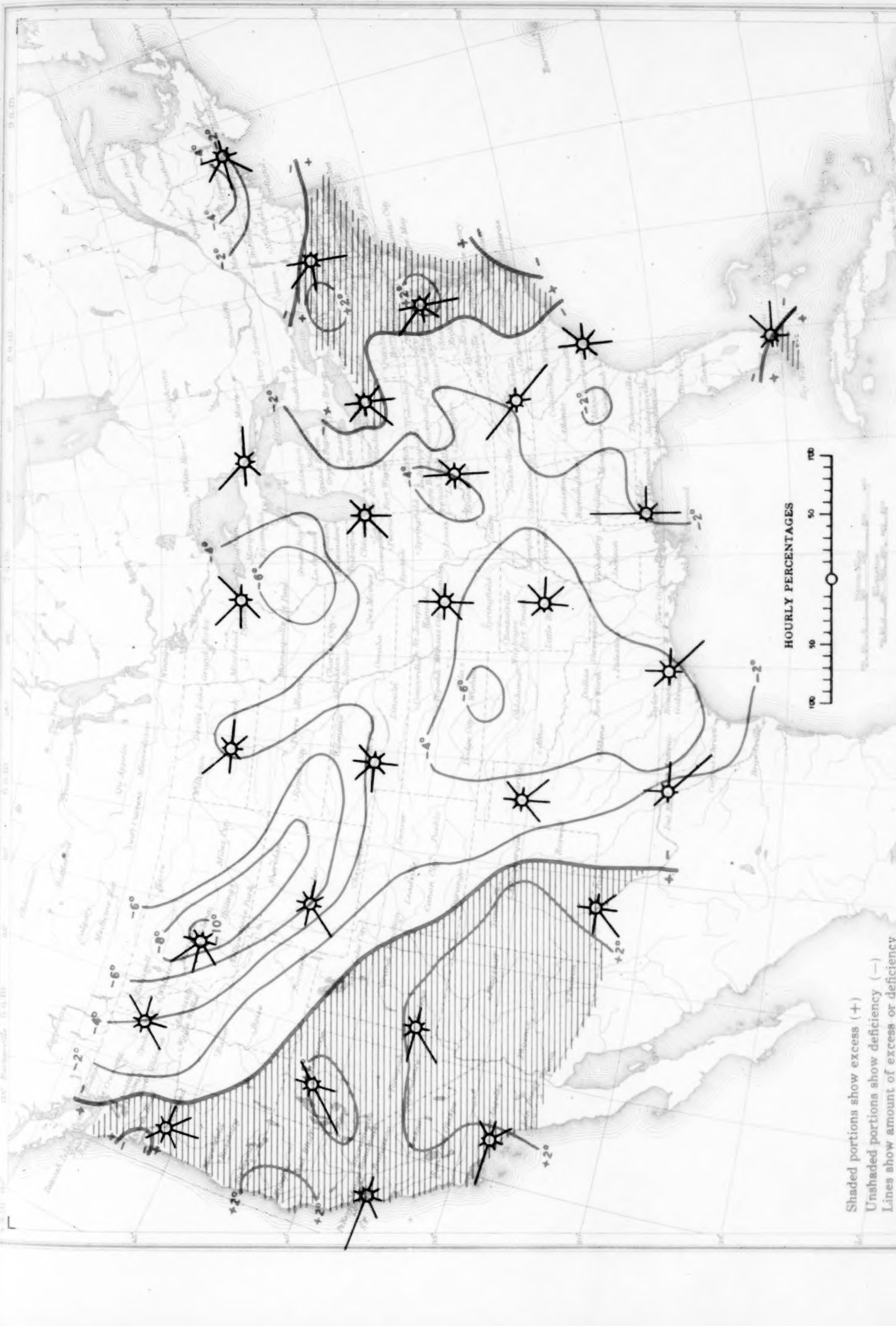
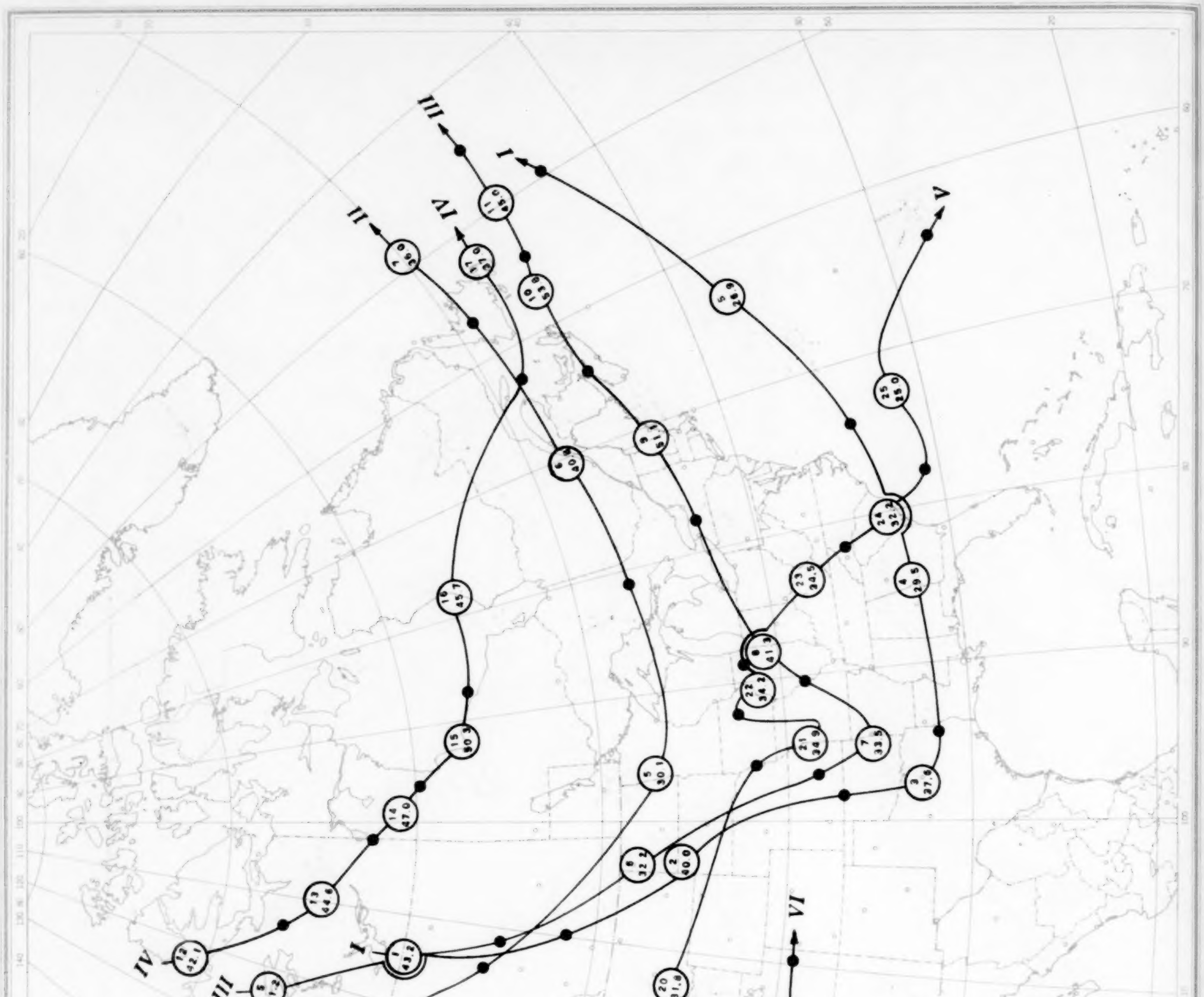


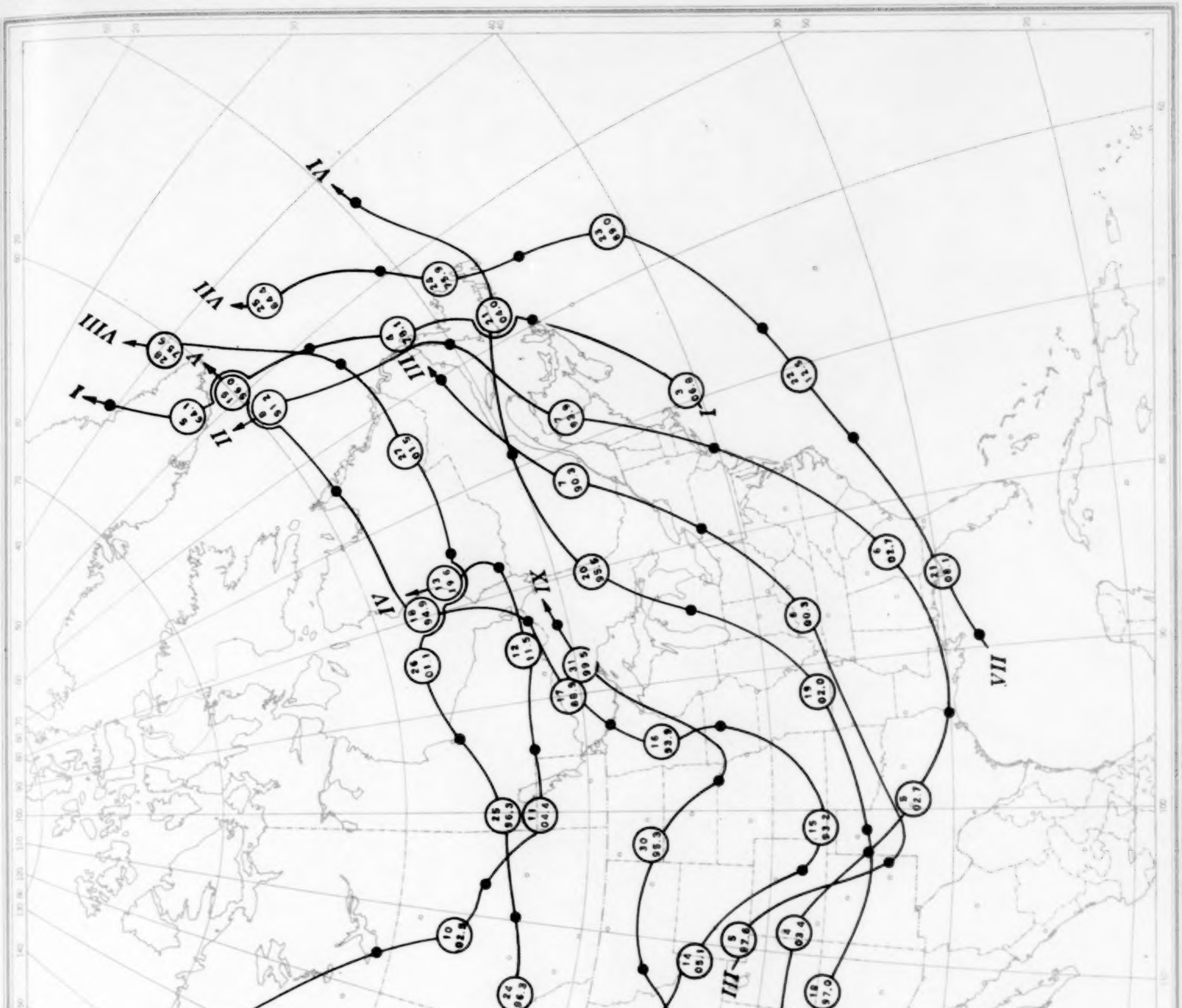
Chart II. Tracks of Centers of Anticyclones, March 1943.



Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 7:30 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, March 1943.

Chart III. Tracks of Centers of Cyclones, March 1943.



Circle indicates position of cyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of cyclone at 7:30 p. m. (75th meridian time)

Chart IV Percentage of Clear Sky Between Sunrise and Sunset, March 1943

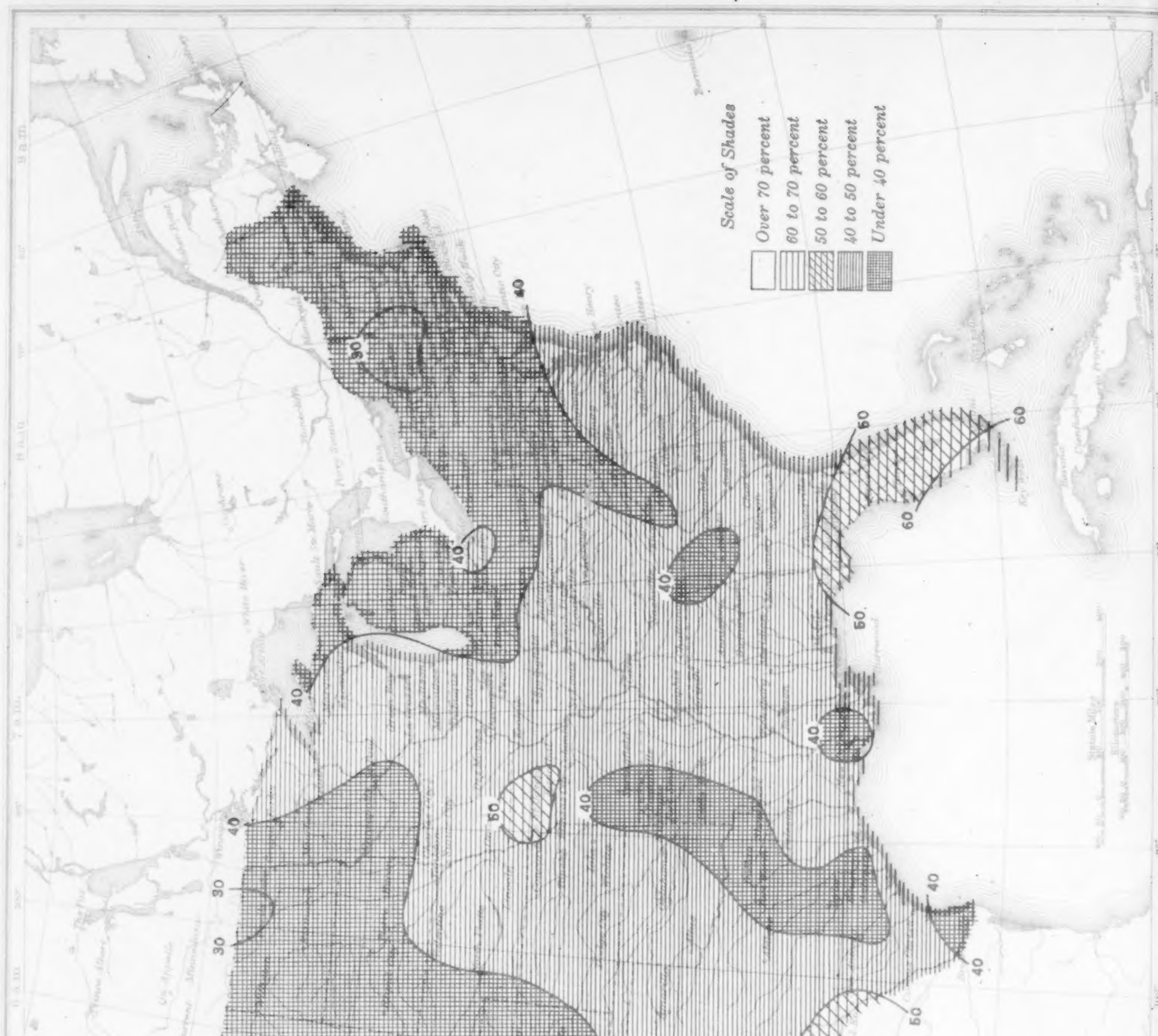


Chart V. Total Precipitation, Inches, March 1943. (Inset) Departure of Precipitation from Normal

Chart V. Total Precipitation, Inches, March 1943. (Inset) Departure of Precipitation from Normal

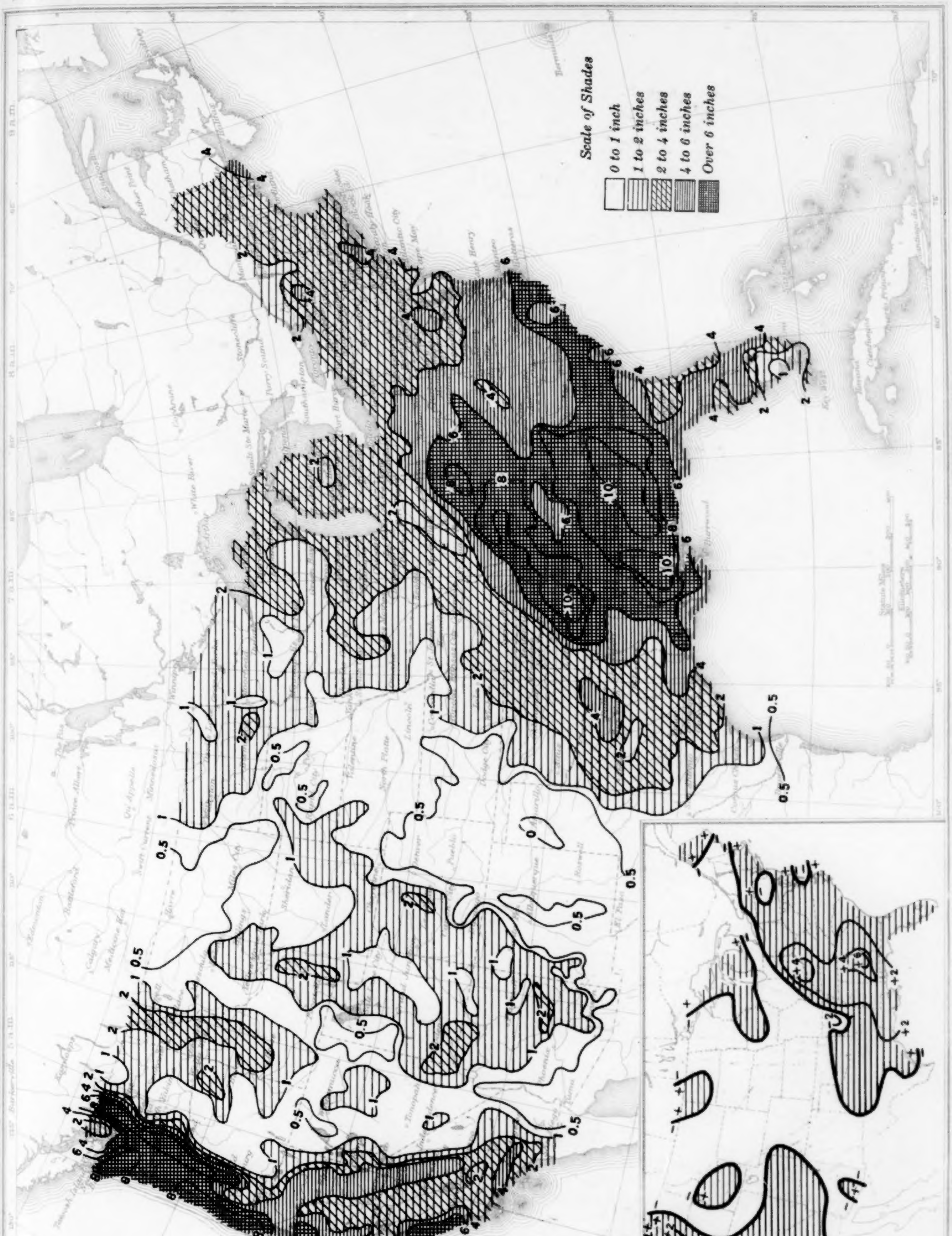


Chart VI. Isotherms at Surface; Prevailing Winds, March 1943

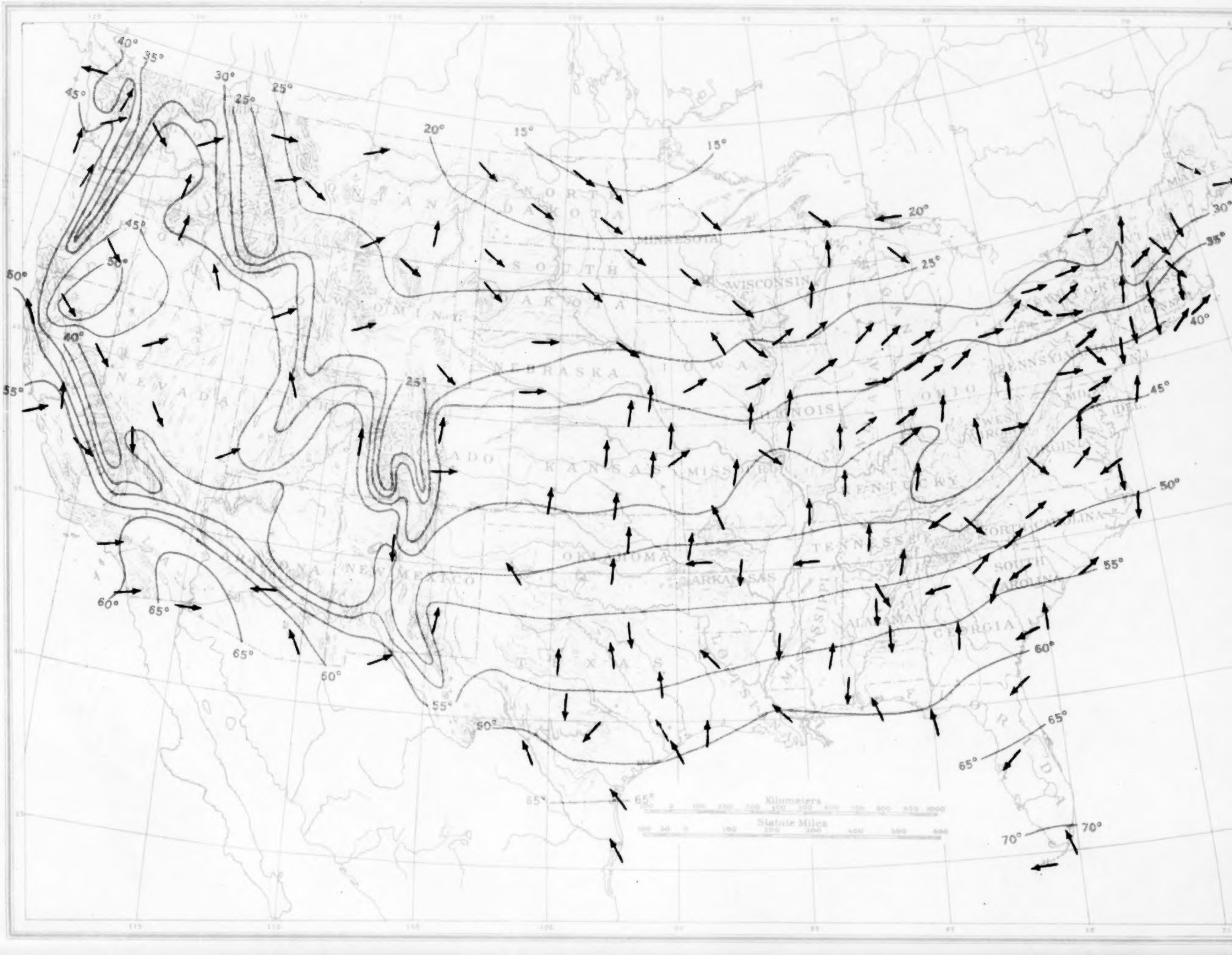


Chart VII. Total Snowfall, Inches, March 1943. (Inset) Depth of Snow on the Ground at 7:30 p. m., Monday, March 29, 1943